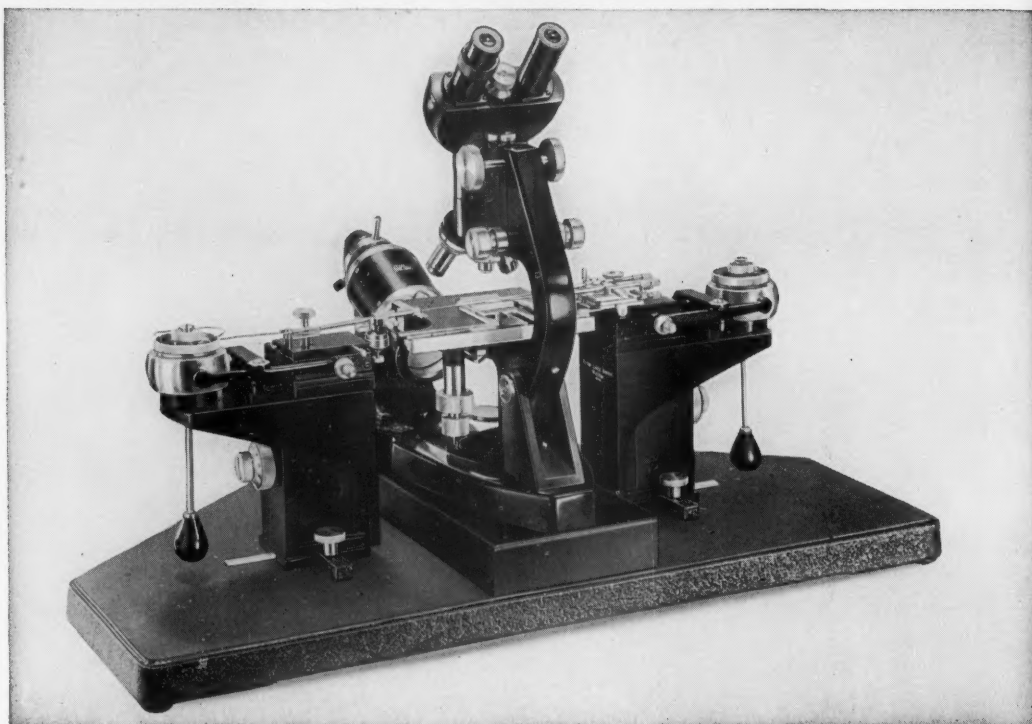


SCIENCE

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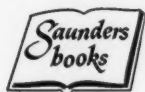
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Strength in Union?

Several recent events in the Department of Defense have brought into focus a dispute over who is to review the weapons' development programs of the three military departments. The dispute was between what might be termed a science judgment, centered in the Office of the Assistant Secretary of Defense (Research and Development), and an engineering judgment, centered in the Office of the Assistant Secretary of Defense (Engineering). In February, the offices of the two secretaries were merged into a single office (Research and Engineering) and, in April, the first man to occupy the new position submitted his resignation. What are the causes that led up to these events? What are the dangers in having separate offices? in having a combined office?

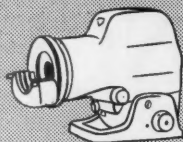
One cause of these events has been the ever larger sums of money needed for developing the ever more formidable weapons. Some idea of present costs can be gained by extrapolation from figures that are no longer classified. Consider, for example, the cost of developing the different airframes (not including engines, fire control systems, and similar items) in the heavy bomber series: 1935, one prototype B-17, \$660,000; 1943, four prototype B-29 bombers, \$8.8 million; and 1952, two prototype intercontinental B-52 bombers, \$55.5 million.

A result of the greater expenditure for weapons has been that the current Research and Development fund of \$1.7 billion, which was reviewed by the Research and Development Office, has not proved enough. Consequently, the Department of Defense has turned to funds nominally allotted for other purposes, including, for example, \$3.5 billion from the Procurement and Production fund. This manner of financing, in turn, has raised the problem of who should review the development projects funded by this additional money, indeed, of who should review all development spending.

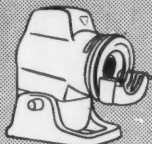
Clearly, both science and engineering judgments are needed. The problem is how to bring them together. With the earlier separate offices, one for Research and Development and one for Engineering, there was the danger that each office would offer its own reviews, that recommendations would conflict, and that conflicts would be resolved by a third party. There is evidence that in a number of cases this is just what happened, and that the role of mediator was played both by the Assistant Secretary of Defense (Controller) and by the Director of the Bureau of the Budget. To be sure, conflicts must be resolved, but it is by no means clear why fiscal judgments should be sought in the evaluation of development projects at this stage.

With the present single office for Research and Engineering, whatever the motivation for the union, one result may be to keep technical matters in technical hands. However, there is the new danger that instead of science and engineering judgments being rendered independently, one viewpoint may come to rule out the other. The first Assistant Secretary for the new office, Frank D. Newbury, formerly Assistant Secretary for Engineering, is not noted for his ability to get along with scientists. We hope that his successor—assuming Newbury's recent resignation is accepted—will have the orientation and ability necessary to achieve a proper balance between science and engineering.—J. T.

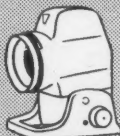
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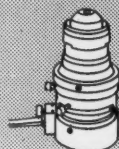
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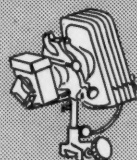
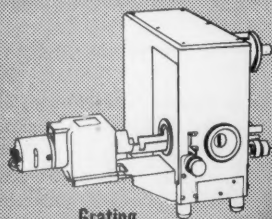


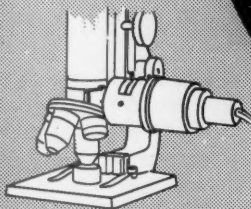
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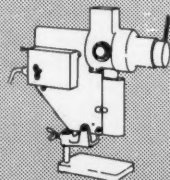
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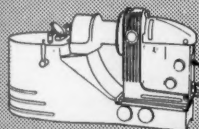
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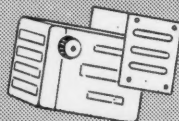
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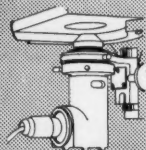
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Psychological Research in Soviet Education

George W. Boguslavsky

Recent reports on the rapid training of scientists in the U.S.S.R. have led to a great deal of interest and speculation. To most of us it seems incredible that a nation, half-illiterate only a generation ago, should outstrip the United States in the size of its technical roster (1). In view of our own shortages, the Soviet figures are disconcerting. They would, indeed, be alarming, were it not for some tendency on our part to question the caliber of Soviet scientific training.

The intent of this article is to suggest that disparagement of Soviet education may be based on emotional, rather than on factual, grounds, and that the better part of valor is to assume that the Soviet system is capable of producing competent scientists. This conclusion was reached after a survey of reports and directives of the R.S.F.S.R. Academy of Pedagogical Sciences, which serve as sources of guidance for school workers. Because these publications are intended primarily for home consumption, they expose failures as well as successes, thus yielding a fairly accurate portrayal of what goes on in the Soviet schools. And the net impression from this portrayal is that the system is highly efficient, despite some rather absurd opinions on the philosophy of education which emanate periodically from the Kremlin.

A factor which has contributed significantly to the efficiency of Soviet education is the active participation of psychologists in the development of teaching methods. This may sound strange in view of our tendency to identify Russian psychology with Pavlov's experiments on salivary conditioning, which seem quite remote from classroom problems. Our appraisal, however, is not entirely accurate. Soviet psychologists, despite assertions to the contrary, have been quite

sensitive to the work done abroad, and some current formulations show unmistakably the influences of Sherrington, Adrian, and Head. Sechenov, regarded as the father of Russian physiology and psychology, paid many a generous tribute to Helmholtz. And Pavlov's own work with anthropoid apes was unquestionably inspired by Köhler.

The impact from abroad is evident in the efforts to deny it, made in 1950 by the joint session of the U.S.S.R. Academies of Sciences and Medical Sciences. At this meeting, dedicated to the centenary of Pavlov's birth, a small group of "distinguished" academicians achieved further "distinction" by groveling before Stalin and by denouncing their more courageous and intellectually honest colleagues. One apparent basis for these denunciations was the willingness of many Soviet scientists to admit that Helmholtz, Hering, Wundt, and Freud had something useful to contribute to psychology (2).

Some principles which find current acceptance in Soviet psychology are described in later paragraphs, in connection with research on teaching methods. First, however, it may be pertinent to examine the manner in which psychologists were drawn into pedagogy and the problems with which they were confronted.

Political Control

The initial step in directing the work of psychologists to education was taken in 1943 with the establishment of the R.S.F.S.R. Academy of Pedagogical Sciences. This is described as a body of distinguished scientists entrusted with jurisdiction over nine research institutes concerned with problems of education.

The Scientific Research Institute for Psychology has been specifically included within this jurisdiction (3, pp. 212-213).

Three years later the Central Committee of the Communist Party issued a directive introducing the teaching of psychology in secondary schools. In this directive, the new academy was instructed to engage in the preparation of textbooks and training of psychology teachers (4, pp. 105-106).

In 1950 the joint session of the U.S.S.R. Academies of Sciences and Medical Sciences passed a resolution instructing presidiums of the two academies to take steps toward development and utilization of Pavlov's doctrines in pedagogical practice (2, p. 131).

The progress made in carrying out this resolution was reviewed unfavorably 2 years later by a member of the Academy of Pedagogical Sciences. This hint at a more active implementation was undoubtedly precipitated by the decision of the 19th Congress of the Communist Party to introduce compulsory 10-year schooling and to convert all secondary education to polytechnical training (3, pp. 205, 252).

To appreciate fully the predicament of Soviet psychologists, it may help to keep in mind the fact that the Central Committee has some definite opinions on individual differences in intelligence. According to one "authorized" definition, intelligence is merely "a well-organized system of knowledge," which clearly implies rejection of the theory of innate differences (5, p. 78). In line with this position, the Central Committee, in its 1936 directive, prohibited segregation of children on the basis of tests, ordered restoration of the majority of retarded children to normal classes, and abolished child psychology as a specialized field of activity in primary and secondary schools. In a parallel decision of 1937, the R.S.F.S.R. Council of Commissars ordered that methods of education in the so-called "exemplary" and "experimental" schools for gifted children be restored to standard pedagogical practices, and that the academic criteria in ordinary schools be raised to the level at which these "exemplary" schools operated (4, pp. 95-101).

Responsibility for school failures is thus placed directly on the teacher. It

Dr. Boguslavsky is assistant professor in the department of psychology at Cornell University, Ithaca, New York.

has been emphasized repeatedly that all pupils have the capacity for successful academic performance, and that expectation of a certain percentage of failures is untenable (6). Moreover, the criteria for success are the absolute academic standards set forth in the 1944 directive of the R.S.F.S.R. Commissar for Enlightenment (4, pp. 174-176). Should any pupil fail to satisfy these standards, the failure is attributed to the negligence or incompetence of the teacher as well as to the laxity of those entrusted with research on teaching methods.

The way in which Soviet psychologists are meeting this challenge is a story of circumvention without obvious compromise of scientific principles. The circumvention is mainly one of giving credit where little or no credit is due, of citing Pavlov, where mention of Sherrington would have been more pertinent, and of treating Marx, Lenin, and Stalin as fountainheads of original philosophic profundities. This lip service, however, does not seem to affect the actual research program, which is generally designed along established psychological principles. To Soviet psychologists the problems of educational methodology are primarily problems of motivation and learning, perception and thought. With this initial assumption, research on pedagogy becomes basic rather than applied, with the classroom serving as the laboratory. Thus, it may be instructive not only for the teacher but also for the professional psychologist to examine the initial assumptions, the nature of experiments, and the ultimate conclusions. The research described in the following paragraphs is presented with this end in view.

Scientific Framework

A concept which has been prominent in Russian psychological theory for many years is that of the *orienting reflex*. In his original description of the phenomenon, Pavlov stated: "If in the surroundings of the animal there appears some new agent . . . then the corresponding receptor surfaces of the organism become focused on it, in a manner which will bring about the most favorable stimulation" (7).

In recent years many Soviet psychologists have favored the broader term, *orienting-exploratory activity* (8). Current descriptions of this phenomenon include two important physiological components: (i) inhibition of movement which might interfere with maximal receptivity, and (ii) tonic innervation, vasomotor and skeletal, preparatory to ensuing action (9). Inclusion of these components makes current definitions of the orienting reflex practically indistinguishable from Henry Head's concept of

vigilance, proposed more than 30 years ago (10).

According to evidence gathered in Russian psychological laboratories, the orienting reaction is an essential mediating variable in learning. Thus, in an experiment on sensory preconditioning, it has been shown that acquisition does not occur unless there are clearly observable head movements in the direction of each of the stimuli. Correspondingly, as long as these movements occur, there is no extinction. With continued orientation the associative connection presumably persists for months and even years (11, p. 298).

Orientation, however, may be a hindrance to learning if the locus of attention is other than the conditioned stimulus. Eighty years ago Sechenov made the penetrating observation that "when a man does not listen to a voice, it is only because he listens to another voice" (12, p. 308); but it was Pavlov who translated this idea into the workable concept of *external inhibition*—a paradigm for the effect of distractors, which has served as a source of research in psychology as well as in education.

The importance attached by Soviet psychologists to orientation has led to some significant deductions and experiments in teaching methods. It is deduced, for instance, that visual aids are useless if their irrelevant details happen to capture the child's attention. Such "external inhibition" apparently is not uncommon in first-grade arithmetic, where toys and blocks are used as aids in addition and subtraction. An important step in teaching arithmetic is to teach the child to recognize that terms like *bought*, *came*, and *acquired* imply addition, whereas *lost*, *spent*, and *departed* imply subtraction. This distinction, however, is in no way illustrated by the mere presence of concrete objects; in fact, children tend to orient to the shape or color of the object, disregarding the required operation.

The use of objects, however, may be quite effective if accompanied by some visual illustration of the required arithmetical process. In a study demonstrating this principle the teacher, while reading a problem, accompanied words like *came* and *bought* with the action of shifting a few blocks toward the child; conversely, words like *sold* and *departed* were accompanied by a shifting of blocks away from the child. On subsequent tests these children showed a higher degree of progress than the controls, who heard the same problems and manipulated the same blocks but were not shown the movement illustrating the nature of the process. "The use of visual aids in the teaching of arithmetic," say the investigators, "appears to be especially effective when illustration is made of those links

of activity which are in the process of forming at the given moment. . . . If in the early stages we obtained better results in the understanding of new material with visual aids maximally representative of reality, at the higher stages we reached such results through the use of the more 'stingy' illustrative materials which underlined and made prominent the essential link in the activity being mastered" (13).

Limitations of Visual Aids

Another study of visual aids was conducted in a class on botany. Here the pupils were supplied with real flowers and, after preliminary instruction, they were told to practice identifying the calyx, the corolla, the stamens, and the pistil. Within the stamens they were to differentiate the filaments from the anthers, and in the pistil they were to point out the ovary, the style, and the stigma. In a comparable class the same procedure was followed, except that the teacher's preliminary instruction was accompanied by references not to the flower itself but to an enlarged drawing of another flower, in which the various organs were shown.

In an examination of the results of these two approaches, it was found that the second group was markedly superior to the first group, not only during practice, but also on subsequent tests with flowers which had not been used in the initial demonstration. Explanation for the relatively poor performance of the first group is offered in the following quotation: "A natural object has immediate significance for the child; it elicits interest which has no direct relation to the organs of the flower. During immediate perception of the flower a teacher's words do not produce sufficient effect." The use of drawings, on the other hand, interferes with the child's initial reaction to the flower and directs his orientation to features which are pertinent to the lesson. In the ultimate outcome, "the stamens and the pistil of a flower are no longer regarded as its merely interesting or pretty parts; they acquire their own special and important significance" (14).

Orientation to nonessential features can also hamper progress in the more advanced courses on mathematics, if the illustrative material is not selected judiciously. One investigator points out that many pupils have difficulty in recognizing a right triangle when the right angle is at the vertex. This difficulty is attributed to the fact that, in most textbooks, illustrations of right triangles are always drawn with the right angle at the base. Thus, orientation toward the critical feature is confounded with orientation toward a particular location.

The point is demonstrated further in connection with the concept of diameter. A beginner in geometry is asked to draw a circle and inscribe a diameter. The pupil inscribes two diameters, one horizontal, the other vertical. This leads to the following dialog:

Teacher: How many diameters can be inscribed in a circle?

Pupil: Two.

Teacher: Aren't there any more diameters?

Pupil: No, there aren't.

Teacher (inscribing a diameter at a 45° inclination): What is this?

Pupil: A diameter.

Teacher: So, how many diameters are there?

Pupil: Two more. Four altogether.

Teacher (inscribing a diameter at a slight inclination from the vertical): How many diameters are there?

Pupil: Any number. I was wrong.

This little misunderstanding is also ascribed to stereotyping in diagrams, since most textbook writers, as well as teachers, illustrate the concept by drawing the diameter in a horizontal position. As a result, the irrelevant feature of location obscures the essence of the definition. It is suggested that such confusion may be avoided if the essential characteristic is illustrated in a variety of positions and in many different contexts (15).

This suggestion is indicative of the attitude of Soviet psychologists toward the role of repetition as a factor in learning. The effect of sheer repetition in a constant environment is generally regarded as trivial, particularly when one expects some positive transfer. On the other hand, repetition in a variable environment is held to be immensely effective. The attitude reflects Pavlov's observation that responses conditioned in one context fail to occur when the context is changed. But the idea of varying the context stems from Sechenov's opinion that perceptions develop from "frequent excitation of receptors under varying conditions of the perceiving organ." This opinion was expressed more than 80 years ago in defense of Helmholtz's concept of "unconscious inference," and it is one of Sechenov's many tributes to his great contemporary (12, p. 267).

Creating Interest in Science

The functional significance of orientation is not restricted to learning. Another field of psychological inquiry in which the orienting reaction is assumed to be a crucial factor is motivation. In application to pedagogy, this assumption has served as the starting point of research on methods of arousing interest and motivation for scientific study.

Soviet psychologists are well aware

that dull books are lethal to pupils' interests, and they concede that books may be dull merely because the subject matter lacks the intrinsic quality of arousing curiosity. Books of this nature may, of course, be made more attractive by insertion of material having the so-called "human interest appeal," but this recourse invariably generates the possibility that such extraneous material may become the principal focus of orientation, to the detriment of the essential scientific topic.

For an illustration of such misdirection of interest, a Soviet psychologist singles out a proposed treatment of a scientific topic, submitted by a contributor to a popular book on geography. The topic, which, according to the psychologist, has little appeal on its own merit, is that of determining geographic location. In an attempt to arouse interest, the contributor introduces description of the method with stories of explorers, adventurers, mountaineers, and fliers who somehow manage to get lost. Each story ends with the question, "Where are we?" Following this introduction the author describes steps in determining the location.

The results of this attempt at popularization are rather sorry. After reading the lesson, children have been asked to name the main theme, to give the lesson a title, to point out the most interesting parts, and to suggest additions to the lesson. As a rule, most children refer to adventures, discoveries, and various heroic incidents described in the stories, while only a small number of the pupils are aware of the main geographic theme.

At this point the psychologist introduces three variations on the human interest appeal. The first of these contains a hero who is bound by duty and honor to discover the location. In the second variation, the hero's primary incentive is ultimate discovery of certain mineral deposits. In the final variation, the hero's motives are of secondary importance, the stress being placed on struggles and frustrations attending his direct attempts to find the location.

While the first two variations produce some improvement in results, the effect of the final variation is in startling contrast to that of the original contribution. For instance, in pointing out the most interesting parts of the original story, only 5 percent of the children mention the essential geographic topic—discovery of location. With the final variation, however, this figure rises to 88 percent. From these results the investigator concludes that "to arouse interest for scientific inquiry we must bring into the text a living, active man, and his living, searching, exploring thought in its historical development. . . . We should not present ready-made results of human thought and experience, but we should introduce the

reader to the very process of investigation, gradually exposing the overcoming of difficulties and the search for the true method. Moreover, to evoke a pupil's interest precisely for the given scientific question, we must treat the search for answer as the main goal of the hero's action, rather than as a means of reaching some other goal. The strife and survival of the hero must be developed around attainment of the given aim" (16).

Language and Thought

The foregoing experiments illustrate the variety of studies in pedagogy generated by just one principle in Soviet psychology. There have, of course, been other points of departure, but space permits only a brief mention of these.

A number of studies are derived from Pavlov's views on the intimate relation between language and thought. In discussing higher nervous activity, Pavlov had postulated two distinct cortical processes, which he called the "cortical signaling systems." The first system, common to man and lower animals, is one connected with immediate perception of environment. The second system is that related to the development of speech; it is man's exclusive property, and it forms the basis of his ability to abstract and synthesize (11, p. 258).

The implication of speech in the development of thought has been described somewhat more specifically in current Soviet literature. According to one investigator, "at various stages of a child's mental development, objects and events are reflected within his cranium in a variety of ways, but they always remain designated by one and the same word. The word remains unchanged. The concept, however, which it denotes as a generalized reflection of objects and events in the environment, becomes altered." From this interpretation the investigator concludes: "Familiarization with language has decisive significance in the formation of consciousness of a growing man. Familiarization with vocabulary and with grammatical structure of language is an essential condition for a child's development of abstract thinking, acquisition of mastery over logical operations and the higher processes of analysis and synthesis. Without language the formation of man's higher sensibilities and of his intelligent will is impossible" (17).

The role of language has been examined at several levels of intellectual development, and the results confirm, with monotonous regularity, its importance as a factor in concept formation. An experiment with 2-year-old children, for instance, shows that a visual demonstration of a simple skill is less effective for

acquisition and transfer than the same demonstration accompanied by a spoken word which names the movement involved in the skill (18). Another study, dealing with a more advanced level of development, shows that confusion in differentiating between causal, temporal, and conditional relations is generated by the ambiguity of the conjunctions *if* and *when*, which are used to introduce subordinate clauses. As an example, the investigator states that a purely conditional statement—"if the weather is good we shall go to the country"—is interpreted by pupils as representing a cause-effect relationship. The implication of the study is that, since this source of confusion is inevitable, the topic of correct identification of relation should be given special consideration in education (19).

Ideation

Several experiments are devoted to the role of imagery in educational methodology. In Soviet psychology, imagery is defined as "a unique form of reflection of objective reality . . . an intervening link in learning about the world: from sensations and perceptions through images toward concepts. As distinguished from perception which is elicited by direct action of an object on analyzers, an image is evoked by stimuli reviving previously formed temporal connections. For man, the specific stimulus capable of evoking imagery is the word." It is pointed out, further, that imagery is not restricted to the visual field but exists as well in other sense modalities (5, p. 29).

Recourse to imagery as a pedagogical technique is shown to be effective in the training of "intellectually passive" pupils—children who, by our standards, would probably be classified as "slow learners" or "retarded." The investigator points out that, in the teaching of addition and subtraction to such children, there is very little transfer from the successful manipulation of blocks to mental operations. On the other hand, if the child doing mental arithmetic is urged to visualize the blocks and to describe his operations aloud, his mental performance can be brought up to the general level of

the class after six or seven such sessions (20).

Imagery has also been used in training first-grade children to abstract the main theme of a story. Usually children tend to repeat the story in part or *in toto*. If, however, they are asked to visualize a picture conveyed by the story and to provide a caption, the concept of the main theme becomes meaningful (21).

A few psychologists have worked on the application of Pavlov's finding that differentiation between a positive and a negative stimulus is achieved most effectively when the two are interspersed during conditioning. The suggestion to teachers of mathematics is that addition and subtraction be taught simultaneously (22), and that understanding of functional dependence is enhanced if pupils are trained in finding the inverse of a function (23). Even in the teaching of psychology it is found that mere definition of a psychological concept is insufficient for long-term retention, and a suggestion is offered that each such definition be accompanied by an active attempt to "criticize, reject, and overcome incorrect, unscientific treatment of the concept" (24).

Conclusions

A conspicuous feature in Soviet research on pedagogy is its high degree of coordination, with every study generated by some psychological principle. Attempts at mere correlations between methodology and success in examinations are practically unknown. In fact, examinations are generally regarded as criteria subordinate to the ultimate goals of long-term retention and transfer.

This concentrated effort is the result, in part, of a commonly accepted premise which many of us regard as untenable—an assumption that "different kinds of habits based on training, education and discipline of any sort are nothing but a long chain of conditioned reflexes" (25).

Whether or not we agree with this formulation, we cannot deny that knowledge is built on previous knowledge. It is highly probable that the Soviet psychologists do not take the statement literally

but regard it as a convenient approximation or a workable formula. With this formula it would be inconceivable that a Soviet psychologist would undertake improvement of high-school teaching without examining all the previous links in the chain, from the kindergarten up. Any academic failure, whether resulting from lack of interest or of ability, is attributed to one or more missing links. Unless these are found and repaired, all further efforts at training in this particular direction are regarded as futile.

References and Notes

1. *Engineering and Scientific Manpower in the United States, Western Europe and Soviet Russia*, 84th Congress, 2nd session, Joint Committee on Atomic Energy print (Washington, D.C., Mar. 1956).
2. *Nauchnaia sessiia posviashchennaia problemam fiziologicheskogo ucheniia akademika I. P. Pavlova* (Akad. Nauk S.S.S.R., Moscow, 1950).
3. E. N. Medynskii, *Narodnoie obrazovanie v S.S.S.R.* (Akad. Pedagog. Nauk R.S.F.S.R., Moscow, 1952).
4. N. I. Boldyrev, Ed., *Sbornik rukovodiashtchikh materialov o shkole* (Akad. Pedagog. Nauk R.S.F.S.R., Moscow, 1952).
5. Iu. A. Samarin, *Ocherki po metodike prepodavaniia psikhologii v srednei shkole* (Akad. Pedagog. Nauk R.S.F.S.R., Moscow, 1950).
6. M. A. Danilov and A. M. Gelmont, in *Puti dostizheniia vysokoi uspevaimosti v shkole*, N. K. Goncharov, Ed. (Akad. Pedagog. Nauk R.S.F.S.R., Moscow, 1954), pp. 7-18.
7. I. P. Pavlov, *Lectures on Conditioned Reflexes* (International, New York, 1928), p. 134.
8. N. Iu. Voitonis, *Predistoriia Intellekta* (Akad. Nauk S.S.S.R., Moscow, 1949), p. 9.
9. E. N. Sokolov, in *Doklady na soveshchaniu po voprosam psikhologii*, A. N. Leontiev et al., Eds. (Akad. Pedagog. Nauk R.S.F.S.R., Moscow, 1954), p. 213.
10. H. Head, *Brit. J. Psychol.* 14, 126 (1923).
11. F. P. Maiorov, *Istoriia ucheniia ob uslovnnykh refleksakh* (Akad. Nauk S.S.S.R., Moscow, 1954).
12. I. M. Sechenov, *Izbrannnye filosofskie i psikhologicheskie proizvedeniia* (Ogiz, Moscow, 1947).
13. P. I. Zinchenko and O. M. Kontsevaia, in *Doklady na soveshchaniu po voprosam psikhologii* (Akad. Pedagog. Nauk R.S.F.S.R., Moscow, 1954), pp. 43-62. Direct quotations from this and other Russian language sources are in my own translation.
14. N. F. Dobrynin, *ibid.*, pp. 82-89.
15. N. A. Menchinskaiia, *ibid.*, pp. 13-24.
16. N. G. Morozova, *ibid.*, pp. 201-211.
17. A. A. Liublinskaiia, *ibid.*, p. 125.
18. ———, *ibid.*, pp. 124-137.
19. M. N. Shardakov, *ibid.*, pp. 62-71.
20. L. S. Slavina, *ibid.*, pp. 181-188.
21. N. A. Menchinskaiia, *ibid.*, p. 21.
22. P. I. Zinchenko and O. M. Kontsevaia, *ibid.*, p. 60.
23. M. N. Shardakov, *ibid.*, p. 67.
24. T. A. Korman, *ibid.*, pp. 89-100.
25. I. P. Pavlov, *Conditioned reflexes* (Oxford Univ. Press, New York, 1927), p. 395.

Humble Oil Company Radiocarbon Dates II

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The radiocarbon ages given in Tables 1, 2, and 3 were determined by the geochemical research group of the Production Research Division, Humble Oil and Refining Company. The method used, which has been described in a previous publication (1), was proportional counting of carbon dioxide that had been prepared from the sample under assay. The counter was filled to an absolute pressure of 5 atmospheres of carbon dioxide in all cases.

The ages are based on a half-life of radiocarbon of 5568 ± 30 years (2) and on an assay of contemporary carbon, whether in the form of organic carbon or calcium carbonate, of 20.27 ± 0.15 counts per minute for the particular counter used. This value was obtained by the extrapolation to zero age of assays of tree rings that were greater than 50 years in age. Background counting rates were in the neighborhood of 5 counts per minute, with a statistical uncertainty of ± 0.07 count per minute.

The ages presented in this article are primarily of geologic interest. The samples analyzed were collected from deposits that mark various stages in the Late Quaternary development of southwestern Louisiana and the adjacent continental shelf. The term *Late Quaternary* as used in this article includes the time from the beginning of the last major glacial advance (Late Wisconsin) to the present day (3). Late Quaternary time in this region may be divided into three distinct units, each of which corresponds to a portion of the cycle of sea-level change which was brought about

by the growth of the Late Wisconsin ice masses and their subsequent deterioration (3, 4).

During the first part of the cycle, sea level was lowered approximately 450 feet as water was withdrawn from the oceans to form the glacial ice masses. In response to the lowering of the base level, streams cut trenches across the coastal plain and the exposed continental shelf. Sea level gradually rose to its present elevation during the middle part of the cycle as the glaciers melted. During this period, the dissected surface of the coastal region became buried with a gradational sequence of sediments consisting of a substratum of sands and gravels and a top stratum of silts and clays. The most recent events of the Late Quaternary cycle have occurred while the sea has maintained a fairly constant level. During this time, the broad deltaic plain of the Mississippi River and the chenier plain of southwestern Louisiana were constructed. The three-fold division of the Late Quaternary cycle forms the basis for the grouping of the samples in Table 1.

Samples from deposits that were laid down during the stillstand of sea level are included in Table 1. They are grouped under two major categories: (i) those from the Mississippi River deltaic plain of southeastern Louisiana and (ii) those from the chenier plain of southwestern Louisiana.

During the stillstand of sea level, the Mississippi River occupied and abandoned a number of courses and distributary systems while building its deltaic plain in southeastern Louisiana. Stages in the progressive development of this plain are readily apparent from a study of the physiographic relationships (4-7). These stages are named either for

streams that now follow abandoned Mississippi River channels or for areas in which the deltas were constructed; from youngest to oldest the stages are A, Plaquemines; B, Lafourche; C, St. Bernard; D, Teche; and E, Maringouin (8, 9). The samples listed in Table 1, part I, date the time of occupancy of these abandoned courses.

While the Mississippi deltaic plain was being constructed, the coastal marshlands of southwestern Louisiana were gradually being built seaward. Stages in this seaward growth are marked by abandoned beach ridges called "cheniers" (10). In order of their development from oldest to youngest, the major ridges are Little Chenier, Perdue Ridge, and Grand Chenier-Oak Grove Ridge (11). Samples in Table 1, part II, were analyzed to provide dates for the cheniers and for the modern beach.

The samples dated in Table 2 were taken from the surface of the continental shelf and from borings located on the deltaic plain and the adjacent continental shelf area. The position of sea level at the time each sample was laid down was estimated by taking into account (i) the elevation of the sample with respect to present-day sea level; (ii) the relationship of the sample to sea level at the time of deposition; and (iii) the amount of postdepositional downwarp and compaction (3). Samples, dating various sea level elevations, are presented under the following three headings: (i) surface of the continental shelf, (ii) top stratum deposits and (iii) substratum deposits.

The samples that are described in Table 3 were taken from borings located on the deltaic plain and the adjacent continental shelf. They were selected in order to establish the age of the basal deposits of the Late Quaternary sequence. Geologic evidence suggests that these samples predate the rise in sea level and that they represent beach and Gulf bottom deposits that were stranded as sea level was lowered. The age of these samples proved to be greater than the maximum obtainable by the radiocarbon method.

Unless otherwise specified in the descriptions, the samples were collected in connection with geologic research on Recent sediments which is being conducted by Humble Oil and Refining Company.

The authors are on the staff of the Humble Oil and Refining Company, Houston, Tex. Mr. Brannon, Mr. Simons, Mr. Perry, and Mr. Daughtry are with the Production Research Division; Mr. McFarlan is with the Geologic Research Section.

Table 1. Radiocarbon dates on samples from deposits laid down during the period of standing sea level. All ages are given in radiocarbon years before the present.

Description	Sample No.	Age (yr)	Description	Sample No.	Age (yr)
I. Mississippi deltaic plain					
A. Plaquemines stage					
Orleans Parish, La. Root of cypress stump buried in natural levee of Mississippi River. The tree grew on deposits	O-62	1200 \pm 100	overlying peat beds that were dated 2650 \pm 110 yr (see sample O-64). The sample was 10 ft below sea level in the building excavation for the Civic Center, Loyola and Howard Streets, New Orleans.		

Description	Sample No.	Age (yr)	Description	Sample No.	Age (yr)
B. Lafourche stage			Metairie; boring, 2 ft below sea level, on the west line of sec. 41, T12S, R10E, 1200 ft south of the Yazoo and Mississippi Valley Railroad.		
<i>Assumption Parish, La.</i> Wood sample from marsh deposits buried by natural levee of Bayou Lafourche; boring, 4 to 5 ft below sea level, 3 mi due east of Napoleonville, Madewood quadrangle, in center sec. 38, T13S, R15E. Submitted by W. G. McIntire, Louisiana State University.	O-87	800 ± 100	<i>Orleans Parish, La.</i> Shells of <i>Rangia cuneata</i> from fine-grained gray sand buried by a relict lake deposit; excavation, 1 ft above sea level, SW¼SW¼ sec. 34, T12S, R12E, Little Woods area.	O-97	2200 ± 110
<i>Terrebonne Parish, La.</i> Peat from a bed of gray clay underlying natural levee of Bayou Terrebonne; boring, 2 ft below sea level, 2000 ft east and 500 ft south of the northwest corner sec. 3, T17S, R17E, Houma area.	O-94	750 ± 100	<i>St. Bernard Parish, La.</i> Wood sample from fine-grained sand underlying natural levee of Bayou La Loutre; boring, 10 to 12 ft below sea level, in SW¼SW¼ sec. 23, T14S, R16E, Hopedale area.	O-107	2200 ± 110
<i>Terrebonne Parish, La.</i> Shell fragments of <i>Rangia cuneata</i> from a fine-grained, clayey sand buried by relict bay deposits; boring, 6 ft below sea level, in the center NW¼ sec. 9, T19S, R15E, Lake Penchant area.	O-100	1380 ± 100	<i>Jefferson Parish, La.</i> Wood fragments from fine-grained gray sand buried by a natural levee of Bayou Barataria; boring, 10 to 12 ft below sea level, 2200 ft south of the north line and 1500 ft east of the west line of sec. 37, T15S, R24E, Crown Point area.	O-115	2400 ± 110
<i>Terrebonne Parish, La.</i> Wood sample from marsh deposit buried by natural levee of Bayou du Large; boring, 6 to 12 ft below the surface, 4 mi south of Houma, Houma SW Quadrangle, 2500 ft south and 2500 ft west of the northeast corner sec. 17, T18S, R14E. Submitted by W. G. McIntire.	O-106	700 ± 100	<i>St. John the Baptist Parish, La.</i> Wood sample from organic-rich, gray clay underlying natural levee of Mississippi River; core, 4 ft above sea level, in southwest corner sec. 47, T11S, R6E, near Reserve.	O-124	2750 ± 110
<i>Terrebonne Parish, La.</i> Wood and peat from fine-grained gray sand underlying natural levee of Bayou Little Coteau; boring, 12 to 14 ft below sea level, 3500 ft east and 1200 ft south of the northwest corner sec. 88, T16S, R14E, Houma area.	O-114	1150 ± 100	D. Teche stage		
<i>Iberville Parish, La.</i> Wood fragments from organic-rich, gray clay underlying natural levee of Bayou Grosse Tete; boring, 4 ft below sea level in NW¼NE¼ sec. 54, T8S, R11E.	O-117	1250 ± 100	<i>St. Mary Parish, La.</i> Wood sample from gray sand beneath natural levee of Bayou Teche; boring, 9 to 12 ft below sea level, in center sec. 37, T14S, R10E, Oaklawn area.	O-101	3800 ± 120
<i>Lafourche Parish, La.</i> Wood and peat from fine-grained gray sand buried by natural levee of Bayou L'Ours; boring, 11 to 18 ft below sea level, in SE¼SE¼ sec. 33, T13S, R17E, Kraemer area.	O-118	1500 ± 100	<i>Plaquemines Parish, La.</i> Wood fragments from fine-grained, greenish-gray sand deposited on the shoreline of the Teche delta; boring, 6.5 to 7.5 ft below sea level on the beach ridge in center sec. 1, T21S, R26E, Lake Washington area.	O-111	3550 ± 120
<i>Jefferson Parish, La.</i> Marine shells from delta front deposits of gray sandy clay; boring, 30 to 32 ft below sea level, in SW¼ sec. 26, T22S, R24E, Grand Isle area.	O-127	920 ± 100	<i>Plaquemines Parish, La.</i> Shells of <i>Thais haemastoma floridana</i> from spoil bank of canal cutting through the same beach ridge in which sample O-111 was taken, in center sec. 1, T21S, R26E, Lake Washington area. The radiocarbon age indicates that the sample is derived from modern material and does not date the beach ridge.	O-85	50 ± 100
<i>Concordia Parish, La.</i> Cypress wood from fine-grained gray sand buried by a Lafourche-Mississippi natural levee; excavation, 20 ft above sea level, in center sec. 42, T1N, R8E, near Coochie. Submitted by Mississippi River Commission, Corps of Engineers, U.S. Army.	O-141	1520 ± 100	<i>Plaquemines Parish, La.</i> Shells of <i>Mulinia lateralis</i> from spoil bank of canal cutting the beach ridge adjacent to the one from which sample O-111 was taken in NE¼NW¼ sec. 12, T21S, R26E, Lake Washington area. The radiocarbon age indicates that the sample is derived from modern material and does not date the beach ridge.	O-121	150 ± 100
C. St. Bernard stage			<i>St. Charles Parish, La.</i> Shells of <i>Mulinia lateralis</i> from a gray clay underlying a natural levee of Bayou Petit; boring, 24 to 25 ft below sea level, in SW¼SW¼ sec. 3, T14S, R20E, Paradis area.	O-112	3050 ± 110
<i>Terrebonne Parish, La.</i> Shells of <i>Crassostrea virginica</i> from a gray, clayey sand buried by relict bay deposits; core, 10.0 to 11.4 ft below sea level, at the mouth of Atchafalaya River, NW¼SW¼ sec. 29, T18S, R12E.	O-7A	1900 ± 150	<i>West Baton Rouge Parish, La.</i> Wood sample from fine-grained gray sand filling an abandoned Lafourche-Mississippi channel; core, 65 ft below sea level, 1800 ft north of the southeast corner sec. 70, T7S, R12E, Port Allen lock site. The age of the sample correlates with dates obtained for the Teche stage, indicating that this sample may have been reworked. Submitted by Mississippi River Commission.	O-151	3450 ± 120
<i>Orleans Parish, La.</i> Peat in swamp deposits now buried by natural levee of Mississippi River. The deposit probably accumulated in lowland adjacent to Bayou Metairie (see sample O-62). The sample was taken 11 ft below sea level, in the building excavation for the Civic Center, Loyola and Howard Streets, New Orleans.	O-64	2650 ± 110			
<i>Jefferson Parish, La.</i> Peat from a layer of clay buried by a natural levee of Bayou	O-90	2320 ± 110			

Description	Sample No.	Age (yr)
E. Maringouin Stage		
<i>Iberville Parish, La. Shells of Rangia cuneata</i> from a gray sand underlying a natural levee of the Lower Grand River; core, 23 ft below sea level at Bayou Sorrel Lock (north gate), SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 2, T11S, R11E. Submitted by Mississippi River Commission.	O-72	5600 \pm 140
<i>Jefferson Parish, La. Marine shells</i> from a white, medium-grained beach sand formed on a shoreline flanking the Maringouin delta; boring, 20 to 25 ft below sea level, 8000 ft south of the north line and 10 ft west of the east line of sec. 122, T12S, R11E, New Orleans area.	O-119	4800 \pm 140
II. Chenier plain of southwestern Louisiana		
A. Little Chenier		
<i>Cameron Parish, La. Shells of Mulinia lateralis</i> from 4 ft below sea level in an excavation at Little Chenier, SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 9, T14S, R6W.	O-6	2520 \pm 110
<i>Cameron Parish, La. Shells of Crassostrea virginica</i> from excavation 2 ft below the crest of Little Chenier, SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 3, T14S, R7W.	O-12A	2750 \pm 200
	O-22	2800 \pm 110
<i>Cameron Parish, La. Shells of Crassostrea virginica</i> from excavation 3 ft below the crest of Little Chenier, SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 3, T14S, R6W.	O-13A	2775 \pm 110
	O-29	3200 \pm 120
B. Perdue Ridge	O-7	2900 \pm 200
		Weighted Average 3150 \pm 120
<i>Cameron Parish, La. Shells of Mulinia lateralis</i> from excavation 1 ft below the	O-7	2750 \pm 110

Description	Sample No.	Age (yr)
surface on the back slope of Perdue Ridge, NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 22, T14S, R6W.		
<i>Cameron Parish, La. Shells of Crassostrea virginica</i> from the surface on the back slope of Perdue Ridge, NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 22, T14S, R6W. The radiocarbon age of this sample is anomalous as compared with that derived from <i>Mulinia</i> shells in sample O-7.	O-11A	6520 \pm 300
C. Grand Chenier-Oak Grove Ridge		
<i>Cameron Parish, La. Shells of Mulinia lateralis</i> from an excavation 4 ft below the surface of Grand Chenier, NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 2, T15S, R6W.	O-8	1220 \pm 100
<i>Cameron Parish, La. Shells of Crassostrea virginica</i> from the front slope of Oak Grove Ridge, NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 6, T15S, R6W. The age of this sample is not in accord with that derived from <i>Mulinia</i> shells in sample O-8.	O-14A	4300 \pm 200
<i>Cameron Parish, La. Marine shell fragments</i> from 10 ft below the surface of Oak Grove Ridge; boring, NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 33, T14S, R7W. This sample was derived from fine-grained Gulf bottom sands underlying Grand Chenier and dates the deposits on which the chenier was formed.	O-142	4550 \pm 130
D. Modern Beach		
<i>Cameron Parish, La. Shells of Mulinia lateralis</i> from the modern Hackberry Beach, SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 9, T15S, R7W.	O-9	520 \pm 100

Table 2. Radiocarbon dates on samples from deposits laid down during the rise in sea level. All ages are given in radiocarbon years before the present.

Description	Sample No.	Age (yr)
I. Surface continental shelf		
<i>Shells of Crassostrea virginica</i> dredged from the floor of the Gulf of Mexico at lat. 28°21'N, long. 92°49'W during the cruise of the research vessel <i>Vema</i> in the spring of 1954. The depth of water at the sampling location was 27 fathoms. The sample was from the beach deposit formed when sea level was about 160 ft lower than it is at present. The abnormally large deviation in age is a reflection of uncertainty in the background counting rate for this particular determination. Submitted by Maurice Ewing, Lamont Geological Observatory, Columbia University.	O-5A	17,500 \pm 2000
II. Top stratum deposits		
<i>Orleans Parish, La. Marine shells</i> from fine-grained gray sand deposited when sea level was a few feet below its present elevation; core, 48 to 51 ft below sea level, at the intersection of Dumaine Street and an artificial levee in New Orleans.	O-75	5400 \pm 140
<i>Plaquemines Parish, La. Marine shells</i> from fine-grained gray sand deposited when sea level was about 110 feet below its present elevation; bit cuttings, 216 to 236 ft below sea level, NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 18, T21S, R31E, Venice area.	O-86	8950 \pm 190

Description	Sample No.	Age (yr)
<i>Plaquemines Parish, La. Marine shells</i> from fine-grained gray sand laid down when sea level was about 240 feet below its present elevation; bit cuttings, 310 to 316 ft below sea level, NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 18, T21S, R31E, Venice area. The age of this sample is anomalous.	O-103	> 35,000
<i>Grand Isle block 16, offshore from Jefferson Parish, La. Wood</i> from a gray clay laid down when sea level was about 70 ft below its present elevation; bit cuttings, 117 to 147 ft below sea level, Humble Oil and Refining Company well No. H-1, Louisiana state lease 799, lat. 29°17.0'N, long. 89°59.5'W. The age of this sample is anomalous.	O-59	12,500 \pm 270
<i>Grand Isle block 18, offshore from Jefferson Parish, La. Peat sample</i> from a black, organic-rich clay laid down when sea level was about 140 ft below its present elevation; core, 226.7 to 227.0 ft below sea level, Humble Oil and Refining Company core test 1, hole 2, Louisiana state lease 797, lat. 29°11'25"N, long. 89°53'00"W. The age of this sample is anomalous.	O-69	> 35,000
<i>Grand Isle block 16, offshore from Jefferson Parish, La. Wood</i> from gray silty clay deposited when sea level was about 135 ft below its present elevation; bit cuttings, 218 ft to 222 ft below sea level,	O-58	> 35,000

Description	Sample No.	Age (yr)	Description	Sample No.	Age (yr)
Humble Oil and Refining Company core test 1, Louisiana state lease 799, lat. 29°09.0'N, long. 88°59.0'W. The age of this sample is anomalous.			<i>Terrebonne Parish, La.</i> Wood sample from bed of sand and gravel deposited when sea level was about 400 ft below its present elevation; bit cuttings, from 386 to 391 ft below sea level, 1000 ft east and 500 ft north of the southwest corner sec. 22, T16S, R14E, Gibson area. This sample may have been contaminated by cuttings from a higher elevation in the boring.	O-105	12,950 ± 280
<i>Plaquemines Parish, La.</i> Marine shell fragments from gray clay deposited when sea level was more than 300 ft below its present elevation; core, 571½ to 572 ft below sea level, Gulf Oil Corporation well No. 3, Buras Levee district, state unit, Scott Bay NW¼NW¼ sec. 28, T23S, R31E. The age of this sample has previously been reported, erroneously, as 21,700 ± 800 years (3). The error arose because of use of an improper background counting rate. Submitted by Marcus A. Hanna, Gulf Oil Corporation, Houston, Tex.	O-1A	> 35,000	<i>Iberia Parish, La.</i> Wood sample from bed of lignitic sand and gravel deposited when sea level was about 225 ft below its present elevation; bit cuttings, 210 to 240 ft below sea level, Humble Oil and Refining Company, well No. 1, Louisiana state lease 2258, center NW¼ sec. 35, T12S, R11E, Bayou Pigeon area.	O-126	13,650 ± 300
<i>Plaquemines Parish, La.</i> Marine shell fragments from core of gray clay, 572-573 ft below sea level, in the same well as sample O-1A. This determination was made to check the corrected age of sample O-1A. Submitted by Marcus A. Hanna.	O-261	> 35,000	<i>Iberia Parish, La.</i> Wood fragments from bed of lignitic sand and gravel deposited when sea level was about 380 ft below its present elevation; bit cuttings, 270 to 300 ft below sea level, Humble Oil and Refining Company well No. 1, Louisiana state lease 2258, center NW¼ sec. 35, T12S, R11E, Bayou Pigeon area.	O-120	> 35,000
<i>Plaquemines Parish, La.</i> Fragments of <i>Oculina diffusa</i> from shell bed formed when sea level was about 210 feet below its present elevation; bit cuttings, 512 to 527 feet below sea level, Humble Oil and Refining Company well No. 8, Louisiana state lease 2090, center sec. 33, T23S, R33E, Southeast Pass area. The cuttings from which this sample was obtained may have been contaminated with material from older deposits.	O-109	> 35,000	<i>Plaquemines Parish, La.</i> Marine shells from fine- to medium-grained sand deposited when sea level was about 130 ft below its present elevation; bit cuttings, 315 to 335 ft below sea level, 3000 ft due south of the northeast corner sec. 38, T20S, R28E, Empire area. This sample may have been contaminated with reworked shells from older deposits.	O-81	> 35,000
III. Substratum deposits			<i>St. Bernard Parish, La.</i> Wood sample from coarse gray sand deposited when sea level was 80 ft below its present elevation; bit cuttings, 73 to 98 ft below sea level, Gulf Oil Corporation well No. 1, Louisiana state lease 2282, lat. 38°08'35.2"N, long. 89°27'25.7"W. This sample may have been contaminated with reworked wood from older deposits. Sample submitted by Marcus A. Hanna.	O-61	> 35,000
<i>Lafourche Parish, La.</i> Marine shells from gray sand deposited when sea level was about 75 ft below its present elevation; bit cuttings, 90 to 100 ft below sea level, in center sec. 51, T17S, R21E, Delta Farms area. Submitted by Mississippi River Commission.	O-73	8800 ± 180	<i>Offshore from Nueces County, Tex.</i> Shells of <i>Crassostrea equestris</i> from a sand and gravel bed deposited when sea level was about 150 ft below its present elevation; bit cuttings, 167 to 182 ft below sea level, Gulf Oil Corporation well No. 1, state lease 41321, tract 744, lat. 27°29.0'N, long. 97°08.3'W. Submitted by Marcus A. Hanna.	O-45	10,700 ± 220
<i>Terrebonne Parish, La.</i> Wood sample from fine- to coarse-grained gray sand with gravel deposited when sea level was about 165 ft below its present elevation; bit cuttings, 386 to 391 ft below sea level, 1000 ft east and 500 ft north of the southwest corner sec. 22, T16S, R14E, Gibson area.	O-99	11,200 ± 240			

Table 3. Radiocarbon dates of samples from deposits predating the rise in sea level. All ages are given in radiocarbon years before the present.

Description	Sample No.	Age (yr)	Description	Sample No.	Age (yr)
<i>Plaquemines Parish, La.</i> Marine shell fragments from sand and gravel bed; bit cuttings, 615 to 870 ft below sea level, Gulf Oil Corporation well No. 3, Buras Levee district, state unit, Scott Bay, NW¼NW¼ sec. 28, T23S, R31E. Submitted by Marcus A. Hanna.	O-4A	> 35,000	803, lat. 29°08'30"N, long. 89°57'50"W.		
<i>Grand Isle block 16, offshore from Jefferson Parish, La.</i> Wood sample from a bed of fine- to coarse-grained sand with gravel; bit cuttings, 417 to 432 ft below sea level, Humble Oil and Refining Company core test 1, Louisiana state lease	O-67	> 35,000	<i>Grand Isle block 18, offshore from Jefferson Parish, La.</i> Wood sample from fine- to medium-grained sand; bit cuttings, 307 to 322 ft below sea level, Humble Oil and Refining Company core test 4, Louisiana state lease 797, lat. 29°12'N, long. 89°52'50"W.	O-68	> 35,000
			<i>Plaquemines Parish, La.</i> Marine shells from a gray clay; bit cuttings, 416 to 436 ft below sea level, NE¼NE¼ sec. 18, T21S, R31E, Venice area.	O-82	> 35,000
				O-92	> 35,000

References and Notes

1. H. R. Brannon, M. S. Taggart, Jr., M. Williams, *Rev. Sci. Instr.* 26, 269 (1955).
2. W. F. Libby, *Radiocarbon Dating* (Univ. of Chicago Press, Chicago, Ill., ed. 2, 1955).
3. H. N. Fisk and E. McFarlan, Jr., "Late Quaternary deltaic deposits of the Mississippi River," in *Geol. Soc. Amer. Spec. Paper No. 62* (1955), pp. 279-302.
4. H. N. Fisk, "Geological investigation of the alluvial valley of the lower Mississippi River" (Mississippi River Commission, Vicksburg, Miss., 1944), pp. 1-70.
5. R. J. Russell, *Bull. Geol. Soc. Amer.* 51, f199 (1940).
6. H. N. Fisk, "Geological setting of New Orleans," a paper presented at a meeting of the Geological Society of America in New Orleans, La., 7-9 Nov. 1955; abstr. in *Bull. Geol. Soc. Amer.* 66, 1559 (1955).
7. R. J. Russell et al., *Louisiana Dept. Conservation Geol. Bull. No. 8*, (1936), pp. 1-193.
8. E. McFarlan, Jr., "Radiocarbon dating of the Late Quaternary in southern Louisiana," a paper presented at a meeting of the Geological Society of America in New Orleans, La., 7-9 Nov. 1955; abstr. in *Bull. Geol. Soc. Amer.* 66, 1594 (1955).
9. W. G. McIntire and J. P. Morgan, "Correlation of prehistoric settlements and delta development," a paper presented at the meeting of the Geological Society of America in New Orleans, La., 7-9 Nov. 1955; abstr. in *Bull. Geol. Soc. Amer.* 66, 1595 (1955).
10. R. J. Russell and H. V. Howe, *Geograph. Rev.* 23, 449 (1935).
11. H. V. Howe, R. J. Russell, J. H. McGuirt, *Louisiana Dept. Conservation Geol. Bull. No. 6* (1936), pp. 1-68.

News of Science

Schweitzer and Libby on Nuclear Tests

Albert Schweitzer has appealed to the world to end nuclear tests. A letter issued by Schweitzer through the Norwegian Nobel Committee was broadcast to approximately 50 countries, though not to the United States. The letter was read in Norwegian by Unnar Jahn, chairman of the Norwegian Nobel Committee, who in 1952 presented the Nobel peace prize to Schweitzer. The impact of the appeal was heightened for Norwegian listeners because the broadcast followed by 15 minutes a report of a recent radioactive rain over Norway caused by Soviet nuclear explosions. Schweitzer's message included the following statements: "From official and unofficial sources we have been assured, time and time again, that the increase in radioactivity of the air does not exceed the amount which the human body can tolerate without any harmful effects. This is just evading the problem.

"Even if not directly affected by the radioactive material in the air, we are indirectly affected through that which has fallen down, is falling down, and will fall down. . . .

"We are forced to regard every increase in the existing danger through further creation of radioactive elements by atom bomb explosions as a catastrophe for the human race, a catastrophe that must be prevented under every circumstance. . . .

"When public opinion has been created in the countries concerned . . . , then the statesmen may reach an agreement to stop the experiments.

"A public opinion of this kind stands in no need of plebiscites or of forming

of committees to express itself. It works through just being there.

"The end of further experiments with atom bombs would be like the early sun rays of hope which suffering humanity is longing for."

Willard F. Libby, member of the U.S. Atomic Energy Commission, has responded to Schweitzer in an eight-page letter to him. After expressing respect for Schweitzer and for the motives behind his appeal, Libby questioned whether Schweitzer "had access to the most recent information" on fallout.

Libby then went on to say that in general the risk from radiation resulting from nuclear tests "is extremely small compared with other risks which persons everywhere take as a normal part of their lives." He urged Schweitzer to weigh this risk against what he believed would be the "far greater risk, to freedom-loving people everywhere in the world, of not maintaining our defenses against the totalitarian forces."

Libby's main thesis was that radiation produced by fallout was far less than the natural radiation to which everyone is exposed. He asserted that a person could get a heavier dose of radiation by moving from the beach to a hilltop or from a wooden house to a brick house than he gets from test fallout.

G.E. Fellowships at Stanford for High-School Mathematics Teachers

Stanford University will award 50 fellowships this year to high-school mathematics teachers from 14 western states for participation in a special 6-week summer program conducted by the department of mathematics of the univer-

sity. The fellowships are supported by a grant from the General Electric Educational and Charitable Fund and pay all expenses, including tuition, room and board, and travel.

Two other similar fellowship programs for high-school teachers, the Shell Merit Fellowship Program and the National Science Foundation Institute for Teachers of Science and Mathematics, are in operation at Stanford, but the General Electric Program is the first which is limited to teachers of mathematics. This limitation has provided an opportunity and a challenge to plan a concentrated and integrated program of training in mathematics which will supplement professional training in the teaching of high-school mathematics.

The aim of such a program, of course, is to increase the mathematical knowledge of the teachers who participate. What mathematics should a high-school teacher know? Most important certainly is the mathematics he teaches. This knowledge is acquired principally through professional training and experience, and the intention of the General Electric Program is to select as fellows teachers who are already competent in this respect. Additional mathematical knowledge will be useful to the teacher if it enables him to place his subjects in a broader context and enhances his ability to stimulate interest. Training of this kind is the specific objective of the program.

With these goals in view two courses have been planned for the program. The first, "Elementary Mathematics from a Higher Point of View," will present subjects which border on high-school mathematics and are at about the same level. Among the topics to be discussed are number theory, whose simplicity and elegance have immediate appeal, and non-Euclidean geometry, whose novelty and connection with modern physics excite interest. Knowledge of such subjects should help the teacher to enrich his classes and direct the curiosity of his better students.

The second course, "Aspects of the Calculus," will present the essential concepts of the calculus, emphasizing ideas rather than technique, and discuss the relationship of these ideas to high-school

subjects. An understanding of the mathematical training which follows high-school instruction should suggest topics for emphasis to the teacher and lend greater authority to his teaching.

Thus the teachers knowledge of high-school mathematics will be extended to contiguous subjects in two dimensions, one might say horizontally and vertically. But there is a third dimension. Knowledge of mathematics is not mere possession of information, more or less systematized. The experience of mathematics as an activity, rather than as a collection of results, is essential to the understanding of mathematics. The characteristic activity of mathematics is problem-solving. Yet very few teachers have had *genuine* experience in problem-solving. It is in this connection that Stanford hopes to make a novel contribution to teacher training in mathematics.

Included in the General Electric Program will be a "Seminar on Problem-Solving," conducted by George Polya. Polya has written extensively on the philosophy and methodology of problem-solving, and his many ideas cannot be discussed here, even briefly. The following outline for the conduct of the seminar which he has written will be of interest, however.

"A plan for such a seminar should not be too rigid. It should have plenty of flexibility to take care of the many relevant points that cannot be assessed in advance: interest, knowledge, personality of the participants. Yet a broad outline can be proposed.

"Problems should be selected from fields with which the participants are already acquainted. The instructor starts with a problem which, for some reason or other, is impressive and uses its solution as a *pattern* for solving several similar problems. The participants, unobtrusively helped by the instructor, should have as great a share as possible in solving these problems in class discussion, and should, as far as feasible, disentangle the 'pattern' themselves.

"After several days' work, the class passes to another initial problem, then to subsequent similar problems, and abstracts another pattern. After two or three such experiences the question of 'very general' patterns is raised. Then the class is prepared for the discussion of such general aspects of problem-solving as generalization, specialization and analogy, the role of guesses, of induction, of plausible reasoning.

"When such questions have been fairly clearly resolved, the final question arises: How should the participants direct the solution of problems in their own classes and reveal the essential methodical ideas? At this stage one of the participants may assume the role of instructor, with the other participants continuing

the discussion after his presentation. Then another participant takes the place of the instructor, and so on."

The two courses and the seminar, with occasional lectures on special topics, constitute the academic portion of the program. Coordinate with this will be a program of field trips to university laboratories and General Electric facilities in the vicinity of the university. During these visits, scientific, engineering, and management personnel will present lectures on mathematical aspects of their activities. The information thus acquired about the role of mathematics in contemporary society and, in particular, in the future vocations of his students should provide the teacher with an important means for motivating the study of mathematics.

The principal criterion for the success of the program will be a simple one. If the enthusiasm of the participants is stimulated, then we may expect that it will eventually be transmitted to their students, and the main objective of the program will have been achieved.

PAUL W. BERG

*Stanford University,
Stanford, California*

AAAS Theobald Smith Award

The Theobald Smith award of \$1000 and a bronze medal, which has been given yearly since 1937 (except for a lapse during the war years) by Eli Lilly and Company of Indianapolis, Ind., under the auspices of the AAAS, will be presented at the association's 124th meeting in Indianapolis, 26-31 Dec. Nominations are now being requested for the award. They may be made by fellows of the AAAS and should be sent to the secretary of the Section on Medical Sciences, Dr. Allan D. Bass, Department of Pharmacology, Vanderbilt University School of Medicine, Nashville 5, Tenn.

The prize is given for "demonstrated research in the field of the medical sciences, taking into consideration independence of thought and originality." Any investigator is eligible who was less than 35 years of age on 1 Jan. 1957 and who is a citizen of the United States. The research is not to be judged in comparison with the work of more mature and experienced investigators.

Nominations must be received *before 1 Sept.* The secretary requests that six copies of all data be submitted. The nomination should include a curriculum vitae, a statement summarizing the nominee's scientific contributions with an evaluation of their significance, and reprints of his or her more important publications. The vice president of Section N-Medical Sciences and four fellows will form the committee of award.

AEC Courses for Faculty

The U.S. Atomic Energy Commission has announced that it will sponsor summer institutes in nuclear energy technology for university faculty at five commission facilities in 1957. Approximately 150 faculty members will attend the sessions at Brookhaven, Argonne, and Oak Ridge National Laboratories, the Ames Laboratory, and the Hanford Plant. Each institute will be conducted by the staffs of commission contractors for a period of 2 months.

Basic courses in nuclear energy technology will be offered at Brookhaven. The curricula will include reactor physics, chemistry and chemical engineering, reactor materials and metallurgy, and reactor instrumentation and controls.

The courses offered at the other four installations will be of a more advanced and specialized nature. Each will require technical education comparable to that gained from participation in the institutes held last summer at the Brookhaven and Argonne laboratories, or the equivalent in work experience.

The AEC will provide cost-of-living stipends up to \$750 per faculty member (matching amount to be provided by each participant's academic institution) and will defray travel expenses. These funds will be administered by the American Society for Engineering Education. No tuition will be charged.

The ASEE will also cooperate with the commission in the selection of faculty to attend the institutes. Inquiries concerning enrollment may be addressed to: W. Leighton Collins, Executive Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill.

U.N. Radiation Committee

The United Nations Scientific Committee on the Effects of Atomic Radiation completed its third session in Geneva, Switzerland, on 18 Apr. A statement issued at the conclusion of the session follows:

"The General Assembly's Special Committee for the study of the effects of nuclear radiation on man and his environment completed its third session today. The meetings were held in private and much of the work was done in specialized subcommittees. Presiding was Prof. Zenon Bacq of Belgium, and Dr. E. A. Watkinson of Canada was vice-chairman.

"The two principal subjects discussed were the question of the genetic effects of radiation, and the committee's report to the General Assembly, which is to be submitted in July 1958. Also studied were measurements of radiation levels,

particularly with respect to radioactive fallout and strontium-90. The committee did not attempt at this time a quantitative assessment of the genetic hazards of radiation. The fundamental purpose of the discussion on this topic was to obtain a consensus of opinion on a number of fundamental points which enter into the field of assessing genetic hazards of radiation. An equally important objective was to define and to exchange views on certain gaps in the existing knowledge of this matter.

"Before the committee were 74 reports submitted by 27 governments up to 8 April 1957, as well as the report of a study group of the World Health Organization and a report from the World Meteorological Organization. A free exchange of ideas on a purely scientific level was held. This discussion was very useful and revealed that there was little divergence among the participating scientists.

"It is hoped that the first draft of the committee's report to the General Assembly will be prepared between now and the committee's next session, which is expected to take place at the end of 1957. The committee fully expects that further information received from governments during this period may cause it to change this preliminary draft but feels that the draft will be most useful as a working paper for the next session. A tentative decision was taken to subdivide the report into the following chapters: Introduction; General; Radiological Data and Methods of Measurement; Fundamental Cellular Radiobiology; Genetic Effects; Somatic Effects; Collected Evaluations; Conclusions and Recommendations.

"It is expected that the somatic effects of radiation will be the principal topic of discussion at the committee's next session."

First South Pole

Temperature Report

The results have been announced of the first soundings of the temperature at the 10,000-foot-high Amundsen-Scott South Pole Station of the International Geophysical Year. Temperatures of -71°F at the surface, -31°F at 3300 feet, and -62°F at 11,500 feet above the surface were reported on 27 Mar. The temperatures were taken by a thermometer attached to a balloon sent aloft with a radiosonde, an instrument that broadcasts information in the form of tone signals to a listening post on the ground.

Because late March roughly corresponds to September in the Northern Hemisphere, temperatures are expected to drop further as the South Pole mid-winter approaches. The station scientific

leader, Paul Siple, has estimated that the temperatures may go down to -120°F .

The lowest temperature observed thus far at the South Pole is -89°F on 2 Apr. 1957. This temperature exceeds the lowest ever recorded for North America, -81°F observed at Snag, Yukon Territory, Canada, in February 1947, and is 1° above the all-time world's record of -90°F set in northeastern Siberia in February 1933.

The study of temperatures and the circulation of air in the Antarctic will yield knowledge of the polar icecap and its effect on the world's weather and, over a longer period of time, world climate. Comparison of the relatively clean air of the Antarctic with the atmosphere of coal and oil-consuming regions is expected to give data on the suspected "greenhouse" effect caused by the release of large amounts of carbon dioxide.

Meteorological data from all the IGY Antarctic stations are relayed to the Weather Central at Little America Station, where for the first time in history twice-daily weather maps of the Antarctic are being prepared. The results of the first South Pole sounding were given to Harry Wexler, chief scientist of the US-IGY Antarctic Program, by Edwin C. Flowers of the U.S. Weather Bureau, chief meteorologist at the IGY Amundsen-Scott South Pole Station.

Occupational Health

Information Exchange

To help industry protect its workers from health hazards arising from the great number of chemicals introduced each year, an Occupational Health Information Exchange is now being set up by the U.S. Public Health Service. The Exchange will be part of the Occupational Health Field Headquarters in Cincinnati, Ohio.

It is estimated that from 1000 to 10,000 new compounds are being developed annually for industrial application. There is need for one central agency to collect and disseminate specific information on the toxicity of these new materials as well as on the substances and processes that have long been used in industry. Sickness absenteeism in industry is equivalent to 2 million workers being off the job each day. Part of this absenteeism is directly related to occupation.

A fund of unpublished information is available from scattered sources. By bringing together this information, it will be possible to predict answers to questions on how new materials and processes may be related to occupational diseases.

The Occupational Health Information Exchange will serve as a clearinghouse on the nature and extent of new disease

problems in industry, total occupational health resources available, and methods for stimulating research in problems under investigation. Data will be provided by industrial establishments, insurance companies, private research organizations, governmental occupational health programs, labor unions, and other federal agencies.

Scandinavian Nuclear Research

The foreign ministers of Sweden, Norway, Denmark, and Finland announced in April that their countries would cooperate in atomic research and that a Scandinavian institute for atomic research would be established in Copenhagen. The four nations also plan to form a joint organization for the exchange of practical applications of nuclear energy.

Radiation Biology

Argonne National Laboratory has announced a special summer course in radiation biology, 1-26 July, at Lemont, Ill. Intended primarily for a limited number of persons with previous experience in biological research, the course will stress general experimental theory and design. Dosimetry and instrumentation needed in doing bioresearch with ionizing and low-energy radiations, and the effect of these radiations on widely diverse biological systems, will be a part of the course. Although not intended as comprehensive preparation in health physics or isotopic tracer techniques, certain special topics of basic interest to these fields will be presented—for example, very low level radiation measurements; multiple tracer techniques; and biosynthetic methods utilizing plants.

Inquiries about the course, for which the fee will be \$25, should be addressed to the Office of the Director, Division of Biological and Medical Research, Argonne National Laboratory, Lemont, Ill. Applications will be accepted from foreign countries as well as the United States. Applications, accompanied by a brief account of educational background, must be received by 1 June.

Army Radio Transmitter

The Department of the Army has announced that a powerful new short-wave transmitter that is effective even when there is severe interference has been developed and will be installed for use by the Pentagon. Called the "World Spanner," the transmitter was designed for the Army's international communication network by the U.S. Army Signal Engi-

neering Laboratories at Fort Monmouth, N.J., and by Continental Electronics, Inc., of Dallas, Tex. The new equipment is almost 50 times more effective than the loudest commercial broadcasting station.

It owes its great power to single sideband design. This is an electronic technique that concentrates the power of a transmitter's signal. Conventional transmitters broadcast three separate signals—a carrier wave and two duplicate sidebands. Single sideband circuits filter out the carrier wave and one sideband, thus funneling all of the power into the remaining sideband. This provides 8 times the strength of conventional transmitters with the same power supply. With ordinary design the World Spanner would have a power of 300,000 watts; with the new single sideband refinements and a new beam antenna now under development, effective power will reach 24 million watts.

Changing channels on a high-power station is usually a major job, but the new transmitter will be almost as easy to tune as a push-button radio. An operator can go on the air at any one of ten previously set frequencies by turning a single switch. The new facility can easily send 64 teletypewriter messages or four separate voices at the same time. It also can transmit at any frequency in the short-wave spectrum from 4 to 30 megacycles, and a second version will cover the range from 20 to 65 megacycles.

Compact design makes the unit smaller than transmitters with far less power; it can be housed in a 50-foot square room. Development of the transmitter was directed by Ralph O. Johnson of the U.S. Army Signal Engineering Laboratories Radio Division.

Proposed Legislation

Of the many bills introduced in Congress, some have a special relevance to science and education. A list of such bills introduced recently follows:

S 1242. Amend National Science Foundation Act to authorize award of scholarships and graduate fellowships to individuals who are not citizens of United States. Jackson (D Wash.) Senate Labor and Public Welfare.

S 1157. Authorize and request President to undertake to mobilize in U.S. an adequate number of world's outstanding experts; coordinate and utilize their services in a supreme endeavor to discover means of curing and preventing cancer. Neely (D W. Va.) Senate Labor and Public Welfare.

HR 4646. Provide for additional research and technical assistance on public health problems created by mosquitoes and other blood-sucking arthropods.

Dixon (R Utah) House Interstate and Foreign Commerce.

HR 4820. Provide for research, study and prevention and treatment of effects of atomic and nuclear radiation on human health, development, and living conditions. Porter (D Ore.) House Interstate and Foreign Commerce.

HR 4752. Amend titles I, IV, X, and XIV of Social Security Act to further assist states in extending aid for medical care to persons eligible for public assistance under such titles. Burns (D Hawaii) House Ways and Means.

HR 4638. Provide a defense cloud-modification program. Berry (R S.D.) House Armed Services.

S 1176. Establish on public lands of U.S. a National Wilderness Preservation System and a National Wilderness Preservation Council. Humphrey (D Minn.), *et al.* Senate Interior and Insular Affairs.

HR 4819. Establish a National Outdoor Recreation Resources Review Commission to study the outdoor recreation resources of public lands and other land and water areas of U.S. Pfof (D Idaho) House Interior and Insular Affairs.

S 1262. Amend Federal Water Pollution Control Act to remove \$250,000 limitation on construction grants under such act. Allott (R Colo.) Senate Public Works.

Scientists in the News

PAUL C. AEBERSOLD, who has been director of the Atomic Energy Commission's Isotopes Extension at Oak Ridge, Tenn., has been transferred to the commission's Washington headquarters as assistant director for isotopes and radiation, Division of Civilian Application. E. E. FOWLER, deputy director of the Isotopes Extension before his transfer to Washington last year, becomes deputy assistant director. The isotopes Extension was made part of the Division of Civilian Application in January 1956, when administrative responsibility for the isotopes distribution program was transferred to the division from the Oak Ridge Operations Office.

CLIFFORD GROBESTEIN, biologist at the National Cancer Institute, Bethesda, Md., has been appointed professor of biology at Stanford University. He is a specialist in developmental physiology and tissue culture.

ROGER ADAMS, past president of the AAAS and head of the chemistry department at the University of Illinois from 1926 to 1954, will be awarded an honorary degree of doctor of science by the university at its June commencement. Adams, who asked in 1954 to be relieved of administrative duties in the

chemistry department to devote full time to research, will retire this fall. He has been a member of the Illinois faculty since 1916.

GAIL M. DACK, director of the Food Research Institute and professor of bacteriology at the University of Chicago, has won the 1957 Pasteur award, which is presented annually by the Society of Illinois Bacteriologists, Inc., to an outstanding bacteriologist in the Midwest.

DESMOND D. BONNYCASTLE, formerly professor of pharmacology at Yale University, is professor and director of the department of pharmacology at Seton Hall College of Medicine and Dentistry.

Another appointment at Seton Hall is that of HUGH G. GRADY as professor and director of pathology, effective 1 June. He is at present scientific director, American Registry of Pathology, Armed Forces Institute of Pathology, Washington, D.C., and professor of pathology (part time) at Howard University Medical School.

EDWARD P. ABRAHAM of Oxford University, Oxford, England, presented the recent CIBA lectures in microbial biochemistry at the Institute of Microbiology at Rutgers University. At present senior research officer at the Sir William Dunn School of Pathology, Oxford, Abraham is known for his contributions to the chemistry of antibiotic substances, especially for his early work on the chemical structure of penicillin and his more recent studies of the chemical composition of peptide and steroid antibiotics, including those of the bacitracin and cephalosporin types.

Distinguished Civilian Service awards, the highest civilian honor in the Department of Defense, have been presented by the Secretary of Defense to six employees. Recipients included WERNER von BRAUN and OTTO WALCHNER, German scientists who came to the United States after World War II. Von Braun is director, Development Operations Division of the Army Ballistic Missile Agency, Huntsville, Ala.; Walchner is a physicist with the Air Force's Air Research and Development Command, Wright Air Development Center, Wright-Patterson Air Force Base, Dayton, Ohio.

The other recipients were ROBERT E. MIEDEL, deputy director of procurement, Headquarters, Air Research and Development Command, Baltimore, Md.; HARRY KRUTTER, chief scientist, Naval Air Development Center, Johnsonville, Pa.; MAURICE R. HILLEMANN, supervisory bacteriologist, Communicable Diseases Division, Army

Medical Service Graduate School, Walter Reed Army Medical Center, Washington, D.C.; and F. REED DICKERSON, Office of General Counsel, Department of Defense.

WALTER O. ROBERTS, director of the High Altitude Observatory of the University of Colorado, has recently been appointed professor of astrogeophysics and head of the university's newly created graduate department of astrogeophysics. He will continue as director of the observatory.

MAURICE EWING, director of the Lamont Geological Observatory of Columbia University, has been awarded the degree of doctor of science by the State University at Utrecht, the Netherlands. The honorary degree was conferred on Ewing by H. W. Obbink, rector of the State University, on the occasion of its 321st anniversary.

LEO A. WALL, a chemist at the National Bureau of Standards, has been presented with the Arthur S. Flemming award, which is given annually to ten outstanding young men in Government by the District of Columbia Junior Chamber of Commerce. Five of the awards are in the administrative field and five in science. Other winners in the scientific field were as follows: ALFRED J. EGGERS, JR., National Advisory Committee for Aeronautics; MAURICE R. HILLEMAN, Department of the Army Medical Corps; HERBERT TABOR, Department of Health, Education, and Welfare; and MANUAL F. MORALES, Naval Medical Research Institute.

EDWIN G. BORING, an experimental psychologist, and ALFRED C. REDFIELD, a physiologist and oceanographer, will retire this summer from the faculty of Harvard University. Boring, who is Edgar Pierce professor of psychology, is the recognized historian of modern experimental psychology. He served as director of the psychological laboratories at Harvard for 25 years and was the first chairman of the psychology department when it became independent of philosophy in 1934. Harvard named him Lowell Television lecturer for 1956-57.

His research has been focused on the field of sensation and perception. In his early work on cutaneous sensitivity, he cut a nerve in his own arm for experimental purposes. His *History of Experimental Psychology* was first published in 1929 and again in a revised edition in 1950. A second volume, *Sensation and Perception in the History of Experimental Psychology*, appeared in 1942.

Boring studied mechanical engineer-

ing at Cornell University, and then shifted to psychology as a graduate student under E. B. Titchener. From Cornell he received the M.E. degree in 1908, the A.M. degree in 1912, and the Ph.D. degree in 1914. He taught at Cornell and at Clark University before joining the Harvard faculty in 1922. He has served as president of the American Psychological Association, as vice president of the American Association for the Advancement of Science, as secretary of the International Congress of Psychology, and as chairman of the Section on Psychology of the National Academy of Sciences. He received honorary doctorates from Clark University in 1956 and from the University of Pennsylvania in 1956.

Redfield, professor of physiology, is a specialist in the functions of the blood. As an oceanographer, he applied the disciplines of physiology to the study of the marine environment in which water and organisms interact. In addition to his Harvard work, he has been associate director and senior oceanographer of the Woods Hole Oceanographic Institution.

Redfield has received the Agassiz medal of the National Academy of Sciences and an honorary degree from the University of Oslo; in addition, he was elected an honorary member of the Marine Biological Association of the United Kingdom last year for his distinguished contributions to oceanography. He made important contributions to the physiology of human and animal organisms before devoting his attention to studies of the sea. His analyses of biochemical cycles in the sea, of the distribution of organisms, and of the products of biological activity led to interpretations of the oceanic circulation incorporating physical, chemical, and biological cycles.

At Harvard, where he began teaching in 1921, he served as the first director of the Biological Laboratories in 1934 and as chairman of the department of biology from 1935 to 1938. He taught for a year at the University of Toronto before joining the Harvard faculty and was, for a summer, visiting professor at Stanford University and later at the University of Washington.

Redfield has been secretary of the American Physiological Society, president of the Ecological Society of America and the American Society of Limnology and Oceanography, chairman of the Natural Resources Council of America, and president of the oceanographic section of the American Geophysical Union. He was on the editorial boards of the *Journal of Comparative and Cellular Physiology* and the *Biological Bulletin* and subsequently became managing editor of the latter.

He studied at Haverford College and at Harvard, receiving Harvard's B.S. de-

gree in 1914 and Ph.D. degree in 1917. He continued his studies at Cambridge University, England, and at the University of Munich.

CHARLES W. CREASER of Wayne State University has been awarded a sabbatical leave for 1957-58. Also, his request has been granted that he be relieved of the chairmanship of the department of biology at the end of the current academic year in order to devote more time to research and teaching upon his return.

STEWART T. GINZBERG, chief of the psychiatry division in the Veterans Administration central office at Washington, D.C., resigned on 1 May to become commissioner of mental health for the state of Indiana. He also will hold an appointment as professor of psychiatry at the Indiana University School of Medicine in Indianapolis.

Recent Deaths

GLACE BITTENBENDER, Jackson, Miss.; 45; professor of anesthesiology at the University of Mississippi Medical Center; 15 Apr.

EDWARD FRANCIS, Washington, D.C.; 85; retired U.S. Public Health Service officer who identified and developed methods to combat tularemia; 14 Apr.

PAVEL P. LAUPMAN, Moscow, U.S.S.R.; 70; leading engineer who worked on the Dnieper hydropower complex, the Kuibyshev and Stalingrad hydropower stations, and the Moscow and Volga-Don canals.

RICHARD S. LULL, New Haven, Conn.; 89; retired paleontologist at Yale University; former director of Yale's Peabody Museum; 22 Apr.

OAKLEY A. MORHOUS, Larchmont, N.Y.; 80; retired chief chemist at the Consolidated Gas Company of New York; 20 Apr.

SEYMOUR OPPENHEIMER, New York, N.Y.; 85; retired specialist in ear, nose, and throat diseases and in plastic surgery; wrote *Surgery of the Middle Ear*; 21 Apr.

WILLIAM G. SAWITZ, Philadelphia, Pa.; 63; professor of parasitology and an associate in medicine at Jefferson Medical College; 19 Apr.

JAMES S. SHAND, Dundee, Scotland; 75; professor emeritus of geology at Columbia University; former professor of geology and mineralogy at the University of Stellenbosch, South Africa; 20 Apr.

WILLIAM F. VERDI, New Haven, Conn.; 84; clinical professor emeritus of surgery at the Yale Medical School and former chief surgeon at St. Raphael's Hospital; 21 Apr.

Reports

Tetrazolium Overlay Technique for Population Studies of Respiration Deficiency in Yeast

Attempts to apply tetrazolium salts to the diagnosis of respiration deficiency in yeast are based on Raut's observation (1) that a white colony found on a tetrazolium agar plate was respiration deficient (aer), whereas red colonies were respiration sufficient (AER). Laskowski (2) demonstrated, however, that growth in the presence of 2,3,5-triphenyltetrazolium chloride (TTC) induced AER cells to produce aer offspring. Recently, Nagai, Yanagishima, Hiraoka, and Takada applied TTC agar overlays to the study of populations of copper-sensitive and copper-resistant yeast cells after colonies had formed on media containing sublethal concentrations of copper (3). This technique allowed the use of a high concentration of TTC in a short test period during which no growth occurred.

This report describes a test procedure for the rapid, direct diagnosis of AER and aer colonies after overlay with TTC agar. Its rationale is based on the use of a relatively high concentration of TTC at a pH that yields deep red color development in AER colonies in a test period sufficiently short so that aer colonies are white. Diagnosis can thus be made in most strains without concern for color ambiguity, growth inhibition, or aer induction by the indicator.

The test medium consists of 1.5 percent Bacto agar in 0.067M phosphate buffer at pH 7.0, 0.1 percent with respect to TTC. Since the TTC is reduced chemically by autoclaving it with the agar, separate stock solutions are prepared and autoclaved. The final test agar is mixed under sterile conditions at 55°C and is stored in the liquid condition in an incu-

bator at 50°C until it is used. For most purposes, sterilization may be omitted since the test period is short.

The test is performed by pouring 20 ml of TTC agar at 50°C over 3- to 4-day-old plates bearing 50 to 100 colonies per plate grown on a conventional peptone-yeast extract nutrient medium containing 1 percent glucose. Red and white colonies are scored routinely 3 hours after overlay.

Preliminary tests were made of several media and of procedural variables with a number of tester strains. Rate of formazan color development with AER strains increased with the TTC concentration up to 0.5 percent, the highest concentration tested. Increased pH also enhanced the rate of color development up to pH 7, with only slight further enhancement up to pH 9. The aer strains tested developed color at a very slow rate, and distinction between AER and aer colonies was possible over a considerable range of pH and TTC concentration. One-tenth percent TTC concentration and pH 7.0 were chosen for routine application because this concentration and pH yielded the greatest apparent differential in the rate of color development of AER and aer colonies. With this medium, at 1 hour after overlay, all essentially homogeneous AER colonies had developed sufficient colony color for a successful differentiation to be made from the white aer strains. At 2, 3, 6, and 24 hours, AER colony color became more intense. The aer colonies were almost all still white at 3 hours, but a few strains had developed faint pink color. At 24 hours, a number of aer strains showed light pink colony color, whereas AER colonies were very dark.

At all intervals between 1 and 24 hours, there was no overlap in colony color between essentially homogeneous representatives of 50 AER and 50 aer strains tested. The latter group included spontaneous variants, meiotic segregants, and variants induced by a number of chemical agents. One aberrant strain, which produced aer variants with a rate of TTC reduction comparable to the AER parental strain, was encountered. Occasional bacterial contaminants revealed themselves by intense color development within a few minutes. Pig-

mentation in adenine-dependent yeast strains did not interfere with TTC diagnosis.

After TTC overlay, several hundred red colonies and several hundred white colonies were picked from plates of essentially homogeneous strains and prepared mixtures. These were subjected to confirmatory test for the phenotype by streaking on lactate agar (4). Results were consistent with the TTC diagnosis with only a few apparent aberrancies. These cases are attributed to experimental error and the dissemination of cells inherent in an overlay procedure.

Applicability of TTC-overlay diagnosis to quantitative population study was tested on prepared mixtures of tetraploid AER and aer strains. The results obtained were consistent with calculations based on control plates and the dilutions. At low frequency of aer cells in the prepared mixtures, the number of colonies per plate was increased to 200. It was possible to estimate 3 percent of added aer cells after correction for the spontaneous frequency of aer cells on the control plates.

Some haploid strains are available which show a high spontaneous rate of AER to aer change during growth. Colonies formed on conventional nutrient media are therefore heterogeneous, the population equilibrium depending on the selective pressures of the growth conditions. A number of such strains were tested by the TTC overlay procedure. Heterogeneity was grossly apparent in some strains which yielded variegated colonies. In one strain, the entire heterogeneous colony yielded grossly homogeneous but lighter formazan color than that observed with homogeneous AER colonies. This case and the previously described aberrant aer strain which reduced TTC at a rapid rate would have been difficult to diagnose by formazan color alone. Diagnosis of the phenotype by the TTC overlay thus appears to have general but not universal applicability. Since both TTC reduction and respiration deficiency may be characterized by multienzyme sites not all of which are necessarily known or common to both, the application to the diagnosis of respiration deficiency is admittedly empirical.

However, the technique does fill a gap in current operations and sometimes offers certain advantages over differential plating on lactate agar (4). TTC overlay enables the direct estimation of a few percent of aer cells in a mixed population. Contact with physical or chemical aer inducers, leading to a viability difference of "damaged" AER cells on glucose and lactate agar, invalidates aer estimation by differential plate count unless the lactate plates are replicated from the glucose plates (5). Here the direct TTC overlay procedure has very evident

All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table or one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in *Science* 125, 16 (4 Jan. 1957).

advantages. When the problem involved is that of estimating low concentrations of AER cells (for example, 0.01 percent) in a predominantly aer population, the advantages of the selective lactate agar technique over TTC overlay become apparent (6).

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References and Notes

1. C. Raut, *Exptl. Cell Research* 4, 295 (1953).
2. W. Laskowski, *Heredity* 8, 79 (1954).
3. S. Nagai *et al.*, *Proc. Natl. Meeting Botan. Soc. Japan* 20, 35 (1955).
4. M. Ogur and R. St. John, *J. Bacteriol.* 72, 500 (1956).
5. The tests of replica plating to lactate agar were made by David Pittman.
6. This work was supported in part by grant N17D from the American Cancer Society.

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Catabolism of Hexuronic Acids by *Erwinia* and *Aerobacter*

Only casual information is presently available on the metabolism of hexuronic acids by microorganisms (1); somewhat greater development of this field is evident with plant (2) and animal (3) materials. Our interest in this subject stems from an earlier study of the pectinolytic action of *Erwinia* soft-rot bacteria in which it was shown that pectin is broken down to galacturonic acid (4) and that the uronate is further catabolized to a mixture of end-products (5). For the past few years we have sought the initial step in the breakdown of galacturonate. We wish now to report that our investigations (6) indicate that the first detectable step in the catabolism of D-galacturonate and D-glucuronate by cell-free extracts of *Erwinia carotovora* and *Aerobacter cloacae* is a reduction, with either reduced triphosphopyridine nucleotide (TPNH) or reduced diphosphopyridine nucleotide (DPNH), to the corresponding hexonic acid, namely, L-galactonate and L-gulonate.

These reductions are carried out by substrate-induced enzymes. Glucose-grown intact cells oxidize glucose at once in manometric experiments, but act on galacturonate and glucuronate only after an induction period. On the other hand, galacturonate-grown intact cells of *Erwinia carotovora* respire galacturonate at once or after a brief induction phase; glucuronate is used very slowly. These galacturonate-grown cells are adapted at the same time to the oxidation of L-galactonate, but not to D-galactonate, D- or L-galactose, mucate, D- or L-lyxose, D-xylitol, L-arabitol, L-ascorbate, L-arabinose, or D-fucose. This sequential in-

duction pattern suggests L-galactonate as a possible intermediate and reduces the likelihood that some often-suggested schemes (1) for galacturonic acid catabolism are operative in *E. carotovora*.

Glucuronate-grown intact cells of *Erwinia carotovora* oxidize glucuronate and galacturonate after a short induction phase; galacturonate- and glucuronate-grown cells of *Aerobacter cloacae* oxidize both uronic acids rapidly without a lag period; the last mentioned cells are sequentially induced to oxidize L-gulonate.

Cell-free extracts were prepared from both *Erwinia* and *Aerobacter* that had been grown on either galacturonate or glucuronate, by sonic oscillation and centrifugation. The supernatant was dialyzed overnight at 4°C against 0.05M tris-HCl buffer of pH 7.2 and centrifuged at 100,000 g for 90 minutes; the clear solution was used. These preparations contain an enzyme that catalyzes the reduction of both galacturonate and glucuronate by TPNH or DPNH. No reduction of D-mannuronate has ever been observed. The enzyme is provisionally named uronic reductase. When a preparation from galacturonate-grown *Erwinia* is used, DPNH reacts slightly faster with galacturonate than it does with glucuronate; when TPNH is the reductant, the reaction with glucuronate is about 5 times faster than it is with galacturonate under the conditions of our experiments. This difference is less distinct with preparations from cells of *Erwinia* grown on glucuronate, or *Aerobacter* grown on either uronate. The activity of the uronic reductase is very weak in extracts from glucose-grown cells of either species.

The end-products of the reduction of the uronates by both bacterial species, with either DPNH or TPNH, are non-reducing, nonlactonized acids: L-galactonate from galacturonate, and L-gulonate from glucuronate. By boiling for 5 minutes with 1N HCl, the acids are converted into the corresponding lactones which, on paper chromatograms, behave in every respect like L-galactono-γ-lactone after galacturonate reduction, or L-gulonono-γ-lactone after glucuronate reduction. It is highly unlikely that the reaction proceeds by lactonization of the uronic acid followed by reduction to the corresponding L-hexonolactone; this opinion is based on (i) the failure of extracts of *Aerobacter cloacae* to reduce D-glucuronono-γ-lactone with DPNH or TPNH, and (ii) the actual accumulation of the free L-hexonic acids taken together with the observed lack of de-lactonizing enzyme activity in the extracts for either of the L-hexono-γ-lactones.

The recent report by Payne (1) regarding the ability of dried cells of *Ser-*

ratia marcescens to form from glucuronic acid a substance tentatively identified as a "1,6-ester linked dihexuronic acid," prompted an examination by us of uronic reductase activity in that microorganism: an enzyme preparation from glucuronate-grown *Serratia* reduces glucuronate with TPNH or, somewhat more slowly, with DPNH. The relationship of the aforementioned reactions to the system described by Isherwood *et al.* (2) in pea mitochondria (which reduces the methyl ester of galacturonate, but not galacturonate, to L-galactono-γ-lactone) is under investigation, as are extensions of this general reaction to some of the less common uronic acids.

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References and Notes

1. S. S. Cohen, *J. Biol. Chem.* 177, 607 (1949); G. Buyze, "De Koolhydraatstofwisseling van *Lactobacillus brevis*," dissertation, University of Utrecht (1955); W. J. Payne, *J. Bacteriol.* 72, 834 (1956).
2. F. A. Isherwood, Y. T. Chen, L. W. Mapson, *Biochem. J. (London)* 56, 1 (1954); L. W. Mapson and F. A. Isherwood, *ibid.* 64, 13 (1956).
3. E. E. B. Smith and G. T. Mills, *Biochem. et Biophys. Acta* 13, 386 (1954); J. J. Burns, P. Peyser, A. Moltz, *Science* 124, 1148 (1956).
4. A. J. Kraght and M. P. Starr, *Arch. Biochem. and Biophys.* 42, 271 (1953).
5. A. J. Kraght and M. P. Starr, *J. Bacteriol.* 64, 259 (1952).
6. This work was supported in part by research grant RG4544 from the National Institutes of Health, U.S. Public Health Service.
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30 January 1957

Effects of Pentobarbital on Intermittently Reinforced Behavior

The behavioral effects of drugs have recently (1-5) been measured in terms of changes in the stable temporal patterns of responding that occur when behavior is reinforced intermittently. It has been shown that drugs may influence both the average rate and the pattern of emission of responses (4). The latter effects are of particular interest, since these patterns probably represent the operation of more subtle behavioral processes than are reflected in the average rate of response. In this report, a new measure of the temporal pattern of responding is used in order to compare the effects of a drug on temporal patterning with the effects on rate of response.

One form of intermittent reinforcement is designated as a fixed-interval

schedule. In this procedure, the first occurrence of the arbitrarily selected response after a fixed period of time makes the reinforcement (for example, food) accessible to the experimental subject. Responses that occur before the fixed time has elapsed have no explicitly arranged consequence. Animals show a characteristic pattern of response when reinforcements are delivered on a fixed-interval schedule (6). For example, if the size of the interval is 15 minutes, then there is usually no responding during the first 5 to 8 minutes of each interval. After this initial pause, the animal begins to respond, at first slowly and then more rapidly; the highest rates occur just prior to reinforcement. This pattern of responding is the most stable and most interesting feature of fixed-interval performance. Inasmuch as this highly reproducible progression of response rates

is correlated with the passage of time, the performance can be viewed as a temporal discrimination.

The behavior generated by the fixed-interval schedule has been used as a base line for the study of sodium pentobarbital and has shown sensitivity in terms of changes in both average rate and temporal pattern of responding (2, 5). In the present experiment (7), measurements were taken of the changes that occurred in the fixed-interval performance when subanesthetic dosages of sodium pentobarbital were administered. The experimental animals were two food-deprived, adult, male, White Carneau pigeons. The response was the pecking of a Plexiglas disk, and reinforcement was brief (4 seconds) access to grain. Prior to drug administration, these pigeons were trained on a 15-minute, fixed-interval schedule of rein-

forcement for about 30 daily experimental sessions.

Each pigeon spent 8 hours a day in a sound- and light-insulated experimental chamber. Reinforcements were delivered on the 15-minute, fixed-interval schedule. After each reinforcement, all illumination in the chamber was extinguished for a period of 5 minutes. The number of key-pecks during this "time-out" was negligible. Each 15-minute interval is considered to begin at the termination of a time-out.

Sodium pentobarbital was injected intramuscularly during the second or third hour of experimental sessions. Drug administrations always took place immediately after a reinforcement; this left 4 to 5 minutes of time-out before the next interval began. Sessions in which there were injections were separated by at least one complete experimental session in which there was no injection. Dosages of 1, 2, 3, and 4 mg of sodium pentobarbital were each administered six times per pigeon. The various dosages were not given in any systematic order.

The top part of Fig. 1 shows the combined results for both pigeons for all injections. The number of responses per 15-minute interval for 12 consecutive intervals is obtained. Six of the 12 intervals are prior to injection and six follow. These numbers are then averaged, interval by interval, for each dosage of pentobarbital. Each curve, therefore, presents average data for 12 administrations (six for each pigeon) of each dosage.

The graded effect of pentobarbital can be seen in the first postinjection interval. In this interval the reduction in average number of responses is a function of the size of the dosage. One milligram does not seem to cause a substantial decrease in response-output. Beginning with the second postinjection interval, there are clear instances of increased responding as a result of administrations of sodium pentobarbital. The magnitude of this "excitatory" effect does not appear to be monotonically related to dosage. There is some indication that the time at which the maximal increase occurs depends on the dosage and that it is later with larger doses.

The number of responses per interval measures the animal's rate of response in successive 15-minute periods. It does not reflect directly the changes that occur in the temporal pattern of responding within single intervals after drug administration. The latter aspect of the drug effect is presented in the bottom part of Fig. 1. The data presented in both parts of Fig. 1 were obtained from the same sessions. The ordinate of the bottom part of Fig. 1 is a measure of the pattern of responding characteristic of the fixed-interval performance. The quarter-life of responses is the time taken, in any one interval, for the first one-fourth of the

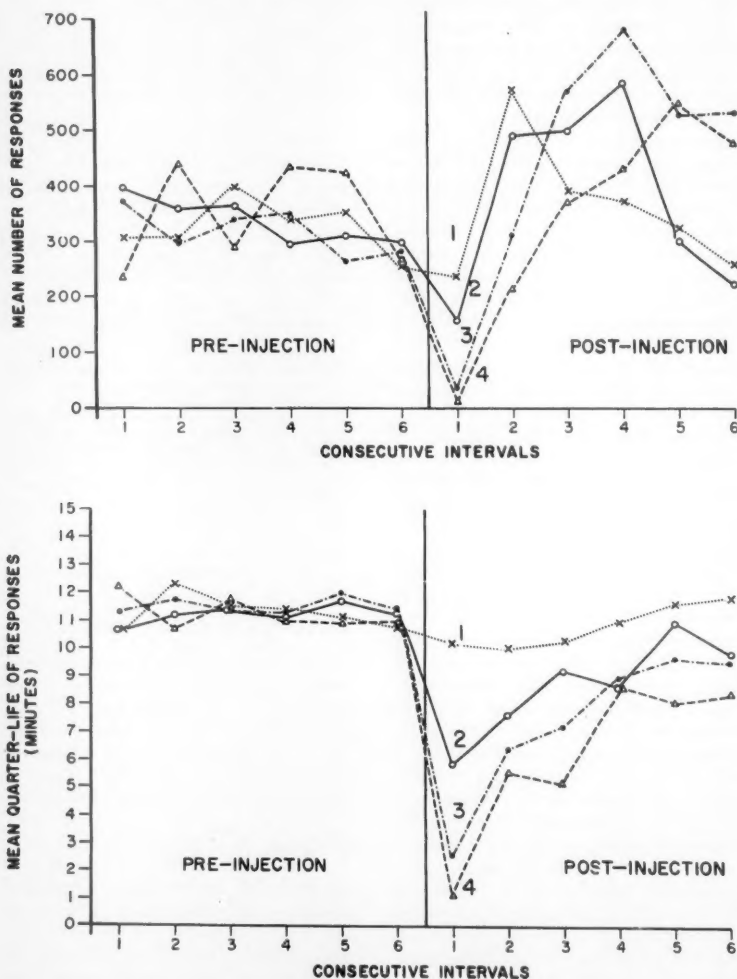


Fig. 1. (Top) Average number of responses per 15-minute interval for 12 consecutive intervals. Each point represents the average of 12 determinations. Numbers on the curves refer to dosages in milligrams of sodium pentobarbital. (Bottom) Average quarter-life for the same 12 consecutive intervals (see text for explanation of ordinate).

total number of responses in that interval to be emitted. For example, if the response rate in some interval were constant, then the quarter-life would be simply one-fourth of the duration of the interval. That is to say, when the rate is constant, one-fourth of the responses will occur in one-fourth of the time. If the responding within an interval has positive acceleration, then the quarter-life will be greater than one-fourth of the interval. On the other hand, if the rate should show a decline within an interval, then the quarter-life will fall below one-fourth.

The quarter-life prior to injection tends to lie between 11 and 12 minutes. This means that about four-fifths of the 15-minute fixed interval has elapsed when the first one-fourth of the responses in the interval have been emitted. The high value of the quarter-life expresses the rate increase that is characteristic of fixed-interval performance.

In the first interval following injection, the average quarter-life falls increasingly further below the base-line value, for 2, 3, and 4 mg of pentobarbital, respectively. This change reflects the loss of the characteristic rate increase within the fixed interval. In the case of 3 and 4 mg of pentobarbital, the quarter-life has fallen below $3\frac{3}{4}$ minutes. This indicates that the responding in these instances shows negative, rather than the customary positive, acceleration.

The time course of the drug effect on the quarter-life is seen in the consecutive postinjection intervals. By the sixth post-injection interval, the quarter-life has almost returned to the base-line value. The effect of sodium pentobarbital, as measured by the quarter-life, is a change in the characteristic pattern of responses associated with the fixed-interval schedule. The magnitude of the change varies directly with the size of the dose and dissipates gradually in time.

The drug effect appears to be analyzable into two components: a depressive effect and a loss of the positive acceleration in responding within the 15-minute interval. The increase in responding, shown in the top part of Fig. 1, is probably a consequence of the change in the temporal pattern of responding within intervals. As the depressive effect disappears, the absence of positive acceleration produces responding that occurs throughout, rather than at the end of, the 15-minute interval, thus increasing the over-all output of responses. The fact that the depressive effect (Fig. 1, top) disappears more rapidly than the loss of discrimination (Fig. 1, bottom) probably accounts for at least some of the increase in responding.

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10 MAY 1957

References and Notes

1. J. V. Brady, *Science* 123, 1033 (1956).
2. P. B. Dews, *J. Pharmacol. Exptl. Therap.* 113, 393 (1955).
3. D. S. Blough, *Ann. N.Y. Acad. Sci.* 65, 334 (1956).
4. W. H. Morse and R. J. Herrnstein, *Ann. N.Y. Acad. Sci.* 65, 303 (1956); M. Sidman, *Ann. N.Y. Acad. Sci.* 65, 282 (1956).
5. R. J. Herrnstein and W. H. Morse, *Science* 124, 367 (1956).
6. C. B. Ferster and B. F. Skinner, *Schedules of Reinforcement* (Appleton-Century-Crofts, in press).
7. This research was carried on in the Psychological Laboratories, Harvard University, with the support of the William F. Milton Fund, ONR contract N5 ori-76, and a grant from the National Science Foundation.

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25 February 1957

On the Distinction between the Effects of Agents on Active and Passive Transport of Ions

Several recent studies (1-3) designed to distinguish between the effects of pharmacologic and other agents on the active and passive components of ionic flux have brought out the difficulties of posing this question within the framework of current definitions of active transport. A brief analysis of the assumptions on which an unambiguous distinction of this kind can be founded seems, therefore, very desirable.

The ability to separate the effects of an agent on the two components of flux hinges, of course, on an experimentally unequivocal distinction between the active or passive components themselves. However, such a satisfactory quantitative distinction does not exist at present, and one is limited to a distinction based on the thermodynamic definition of active transport as transport against an electrochemical potential gradient. This definition was given by Rosenberg (4). The principal objection to this formulation is that it defines active transport in terms of a *net*—that is, a necessarily unidirectional—active flux. It specifically excludes metabolically linked transport (i) that is codirectional with and in excess of that expected from the electrochemical potential gradient and (ii) that is opposing but incompletely compensating the flux resulting from the gradient. One would intuitively wish to include both of these. The definition contains nothing to justify an interpretation of the net flux as a difference between two "active" components in the two directions, as has been suggested. In addition, it encompasses transport processes that require a supply of energy but do not derive it from metabolic reactions—for example, those leading to a Donnan equilibrium.

It may seem that one could define active transport as transport specifically

coupled with metabolic reactions, without reference to the direction of the resulting net flux. However, in the absence of a precise knowledge of the mechanisms involved or of a possibility of measuring "passive" permeability coefficients in the *undisturbed* living system, such a definition does not prove experimentally meaningful. Numerous attempts have been made to arrive at a value for the thus defined "passive" term through the use of metabolic inhibitors. That it is, however, impossible in principle to make an unequivocal distinction between "active" and "passive" or even "metabolically dependent" and "metabolically independent" components of flux *solely* on the basis of experiments with metabolic inhibitors can be seen from the following considerations.

According to the most general definition, the isotopically measured flux in either direction would be expressed as a sum of a "passive" and an "active" term. The passive term should in principle be given by the product of a permeability coefficient, which is determined by the properties of the cell membrane and the activity of the ion on the side from which the flux originates. In the absence of evidence to the contrary—and such evidence is unobtainable without a clear-cut identification of the "active" term—the permeability coefficient must be assumed to depend on the state of metabolism as well as on ionic activity. Any metabolic inhibition must therefore be assumed to alter the permeability coefficient by an unknown amount and in an unknown direction. Thus one may not regard its measured value even as a meaningful extremum, making a distinction between the "active" and "passive" terms on this basis impossible.

More difficult to foresee is the impossibility of distinguishing by this approach between the components of flux which *are* and those which *are not* dependent on metabolism. We may represent the total (measured) flux by an equation such as

$$f_t = p^o \pi(m) a_o + f_i^*(m) \quad (1)$$

where f_t is the total inward flux, p^o the value of the permeability coefficient in the complete absence of metabolism but with all other independent variables returning their values, $\pi(m)$ an unknown function describing its dependence on the rates of metabolic reactions, a_o the activity of the ion on the outside, and $f_i^*(m)$ the unknown active transport term. Even if perfect metabolic inhibition were achieved, there is no means of ruling out any effect of the inhibitor on the membranes, which itself is independent of metabolism, so that again the measured value p^o may in no way reflect even an extreme value of p^o . In other

Table 1. Survey of possibilities. If $R_f' = R_f$, there is proportional enhancement of both active and passive transport or proportional depression of both, or no effect.

$R_f' > R_f$		$R_f' < R_f$	
Condition	Result	Condition	Result
A. f_i increased, f_o unchanged	Enhancement of active transport	A. f_i decreased, f_o unchanged	Depression of active transport
B. f_o decreased, f_i unchanged	Depression of passive term, exactly compensated by enhancement of active term	B. f_o increased, f_i unchanged	Enhancement of passive term, exactly compensated by depression of active term
C. f_i increased more than f_o	Enhancement of both active and passive transport	C. f_i increased less than f_o	Enhancement of passive transport
D. f_i decreased less than f_o	Depression of passive transport	D. f_i decreased more than f_o	Depression of both active and passive transport
E. f_i increased, f_o decreased	Enhancement of active transport and depression of passive transport	E. f_i decreased, f_o increased	Depression of active term and enhancement of passive term

words, all parameters in Eq. 1 have to be considered as functions of the newly introduced variable, the agent, even if they would represent meaningful mutually exclusive terms in its absence. Consequently any definition that requires the introduction of an additional variable breaks down on a priori grounds. Thus a distinction between the effects of an agent on the two separate components of flux, if it is to accomplish its purpose, should be based on an independent, physical definition of active transport, such as that of Rosenberg. This can be accomplished under the following conditions.

For reference, the defining equation for the active-transport term can, in analogy to the equation derived by Ussing (5) be written in the form

$$R_f = \frac{f_i}{f_o} = \frac{P_i a_o + f_i^*}{P_o a_i} \quad (2)$$

where f_i is the isotopic inward flux, f_o the outward flux, f_i^* the "active" flux, a_o and a_i the electrochemical activities outside and inside, respectively, and P_i and P_o the inward and outward permeability coefficients. Equation 2, really a composite of two equations, contains one more undetermined variable than the number of equations. Hence, if one is to decide whether active transport occurs in a given case, a different expression, containing only measurable quantities, has to be used. Since the only restriction on the relationship between fluxes and activities imposed by the definition of active transport is that $f_i > f_o$ as long as $a_o > a_i$ and vice versa, given a permeable membrane, such an expression is given by

$$\frac{R_f - 1}{R_a - 1} > 0 \quad (3)$$

where $R_a = a_o/a_i$. As long as this relationship is satisfied, transport is to be

regarded as passive. Equation 3 is less restrictive than that derived by Ussing (5), but it is the only obligatory statement of the afore-mentioned definition of active transport. Glynn (6) has made use of two equivalent inequalities in discussing possible deviations from Ussing's equation, without, however, pointing out that they could be properly used in defining active transport. Implicitly, the relationship of Eq. 3 has been used by Hodgkin and Keynes (3) in deciding that the transport of K^+ in the giant squid axon was passive after administration of dinitrophenol. The latter authors have also pointed out that Ussing's original equation requires further assumptions and does not furnish a criterion for the occurrence of active transport, except in special cases. It might be noted that the only condition under which Ussing's equation is valid by thermodynamic arguments alone is $a_o = a_i$, for which Eq. 3 becomes indeterminate. This is also the only condition under which the active transport term can be numerically evaluated, since it does not follow from thermodynamic arguments that the permeability coefficients in the two directions (both being functions of concentration) are equal, except at $a_o = a_i$.

Once the occurrence of active transport in a given system has been ascertained, an attempt to separate the effects of an agent on the active and passive components is possible only on the further assumptions that the agent affects the inward and outward permeability coefficients in the same sense and in equal proportions and does nothing to alter the activities. Experimentally, this requires the measurement of the flux ratio R_f in the absence and in the presence of the agent. If the agent depresses the permeability coefficients, without an effect on active transport f_o' will be decreased more than f_i' , so that $R_f' > R_f$, the

quantities measured in the presence of the agent being designated by primes. A decrease of active transport alone will depress f_i' , but leave f_o unaltered, so that $R_f' < R_f$. Depression of both the active and passive term will also yield $R_f' < R_f$, but accompanied by a decrease in both f_i' and f_o' . A complete survey of possibilities is tabulated in Table 1. Except in the case where no change of the flux ratio is observed, the four measurements combined with the demonstration of constant activities provide a rather unambiguous separation of the effect of an agent on the active and passive components of the total flux, as defined thermodynamically. It must be kept in mind, however, that this definition and the procedures based on it in no way reflect effects on all the metabolically linked components which may actually occur in living systems. They are of value only insofar as the latter type of information is not obtainable at present with any degree of reliability (7).

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References and Notes

1. A. Shanes, *Science* 124, 724 (1956).
2. — and M. Berman, in preparation.
3. A. Hodgkin and R. Keynes, *J. Physiol. (London)* 128, 28, 61 (1955).
4. T. Rosenberg, *Acta Chem. Scand.* 2, 14 (1948).
5. H. H. Ussing, *Physiol. Revs.* 29, 27 (1949).
6. I. M. Glynn, *J. Physiol. (London)* 134, 278 (1956).
7. I am very much indebted to A. M. Shanes and C. A. M. Hogben for a critical discussion of the manuscript. This article is contribution No. 2144 from the Gates and Crellin Laboratories of Chemistry, California Institute of Technology.

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Diathelic Immunization—a Maternal-Offspring Relationship Involving Milk Antibodies

The extraordinary speed with which the mammary gland returns specific antibody upon direct immunization with bacterial antigens has led us to experiments testing the hypothesis that in intercurrent infections of the young, injection of the antigen through the teat orifice during the act of nursing may lead to the return of specifically immune milk. Nine normally lactating cows were used, and in each experiment a live culture of *Salmonella pullorum* was instilled into the mouth of a calf during a single nursing. This species of bacteria was chosen because it is not a resident or pathogen of cows. Only two quarters of the udder were offered to the calves in each instance. The organisms were prepared as washings from 24-hour cultures on veal broth slants. Testing of the milk

Table 1. Appearance of agglutinating antibody in two quarters of cow No. 340 following exposure to *Salmonella pullorum* during a single nursing. Plate agglutination of milk.

Quarter	Titer	Time after exposure (hr)									
		0	2	4	6	8	24	48	72	96	
Front	1/100	-	-	-	-	+	+	+	+	++	
Front	1/10	-	-	+	+	++	++	++	++	++	
Rear	1/100	-	-	-	-	+	+	+	+	+	
Rear	1/10	-	-	-	+	++	++	++	++	++	

before and after the exposures was performed by plate agglutination.

With the nine cows which were used, a total of 17 experiments were performed, nine of which showed antibody return induced by the exposure. The findings are illustrated in Table 1 which shows that the agglutination test became positive in the front experimental quarter in 4 hours, in the rear experimental quarter in 6 hours. These early antibody returns to what must have been very small injections of live bacteria appeared within reaction times which we have found characteristic of the cow's udder (1). The possibility exists, however, that, through some cross immunity with the species of *Salmonella* normally inhabiting the cow, an anamnestic reaction was involved. In this connection, the experiment illustrated in Table 2 is noteworthy. In this instance, the exposure to the organism by way of the calves' mouths did not induce enough antibody for a positive agglutination test until 24 hours later. Six days after the first exposure, the two experimental quarters were again negative and the experiment was repeated. This time, the reaction was more prompt, with a definite titer being recorded 7 hours after the exposure.

The mammary gland functions as an exocrine reticuloendothelial gland (2). This status is made more meaningful by the delineation of the process whereby the act of suckling can inject organisms into the gland and thus cause an outpouring of specific antibody in subsequent feedings. We suggest the term *diathelic* (δια, through; θηλη, teat) immunization for this phenomenon and the term *diathelic immunity* for the state induced.

Augmenting the well-known transmission of maternal immunity to the young via colostrum, and in some species via the placenta, this hitherto unsuspected relationship puts at the disposal of the offspring a large amount of antibody-forming tissue at the time at which its own reticuloendothelial organs are inadequate. The anamnestic response is apparently important here in that the previous exposures of the maternal tissues make augmented responses possi-

ble. It is likely that certain pathogenic species, scarcely represented in the placental or colostrum transmission because they are poor antigens, may give effective antigenic stimuli following diathelic immunization provided that there has been previous exposure earlier in the mother's life.

Contrary to many statements in the literature, effective absorption of antibody from the gastrointestinal tract does occur after the neonatal period; thus transmission of immunity with milk may be presumed to occur for the duration of nursing. There is evidence (3) that, in infant diarrhea at least, the absorption of unaltered protein is facilitated, an effect which would heighten the usefulness of this mechanism. The importance of natural feeding rather than artificial in the human infant must be assessed in terms of these new data as must, also, the varying weaning customs of primitive peoples. Though a definite advantage in breast feeding with regard to infection and mortality is persistently reported (4) in this country, it is apparent that where sanitation is conspicuously poor, the advantage is very much greater (5). In calves, similarly, completely artificial feeding may be used with some success only on premises where cattle have not been raised before.

Biologically considered, it is evident that through this process of diathelic immunization the mammary gland becomes a part of the bodily economy of the young. In this way, the immunity-producing tissues of the offspring are greatly augmented, and the problem of survival in the face of the ubiquity of bacterial and perhaps viral pathogens is reduced. It may even be asked whether the value of the mammary gland as means of generating protective immunity in the young may not outweigh its nutritional importance. Considering the success with which the birds, for example, have met the problem of nourishment

of the young under a wide range of conditions, we feel that the origin and evolutionary survival value of the milk-producing organ of mammals may depend primarily on its protective action in disease rather than on its function in the nourishment of the young (6).

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References and Notes

1. B. Campbell and W. E. Petersen, unpublished observations.
2. W. E. Petersen and B. Campbell, *J. Lancet* 75, 494 (1955).
3. F. L. Grusky and R. E. Cooke, *Pediatrics* 16, 763 (1955).
4. Compare, for example, S. Stone and H. Bakwin, *J. Pediatr.* 33, 660 (1948).
5. S. S. Stevenson, *J. Am. Dietet. Assoc.* 25, 752 (1949).
6. This work was supported by a grant from the American Dairy Association.

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Strontium-90 in Man

The strontium-90 data on the retention of fission fallout in man, as reported by J. L. Kulp, W. R. Eckelmann, and A. R. Schuler [Science 125, 219 (1957)], provide the first sound basis for evaluating the biological hazards from Sr⁹⁰ on a quantitative scale. While the authors present excellent data, their conclusions are open to serious criticisms, a number of which are itemized in the following paragraphs.

1) The biological hazard of Sr⁹⁰ is most important in human beings born since the Castle series of nuclear tests (beginning with the 1 March 1954 explosion). Thus the pertinent age group, for measurements made in 1955, is 0 to 1.5 years. It is somewhat misleading to present Sr⁹⁰ bone retention data as an average value for ages 10 to 80. This is especially significant since infants show a much higher uptake of strontium than do adults.

2) Statistics on Sr⁹⁰ retention in infants are too limited to permit careful evaluation of the biological hazard. Furthermore, it is again misleading to speak of averages for strontium retention in infants. Our concern should be with the fraction of infants who get, say, 10 times the average value, for we certainly do not wish to consider the radiation risk on a total basis.

3) The authors assume that their data reflect the establishment of an equilibrium condition in fallout and uptake of Sr⁹⁰. About a year elapsed between stratospheric injection of the fission debris and the time of bone measurement. The bomb-to-bone sequence is an intricate

Table 2. Appearance of agglutinating antibody in udder of cow No. 885 at various times following two successive exposures to *Salmonella pullorum* during nursing at a 7-day interval. Plate agglutination of milk. Left quarters control, right quarters experimental.

Quarter	Titer	2 Mar. 1956			8 Mar. 1956			
		Time (hr)			Time (hr)			
		9	24	48	5	7	24	96
Left front	1/100	-	-	-	-	-	-	-
Left front	1/10	-	-	-	-	-	-	-
Left rear	1/100	-	-	-	-	-	-	-
Left rear	1/10	-	-	-	-	-	-	-
Right front	1/100	-	+	-	±	+	++	++
Right front	1/10	-	+	+	+	+	++	++
Right rear	1/100	-	+	+	±	+	++	++
Right rear	1/10	-	+	+	+	+	++	++

one involving the possibility of hold-up in the food chains. For example, dairy cattle fed on stored herbage would contribute less Sr^{90} to dairy products than those on open range.

4) In the case of stillbirths, Sr^{90} data may be distorted by nonnutritional calcium prescribed for many pregnant women.

5) The authors continue the Atomic Energy Commission practice of reporting Sr^{90} concentrations in terms of maximum permissible concentrations (MPC) which are strictly meant to apply only to healthy, occupationally exposed adults. The MPC for children, to be consistent with the recommendations of the National Commission of Radiological Protection, ought to be 1/20 the occupational MPC.

6) Values for MPC have been revised downward steadily during the past two decades as more knowledge of the ultimate biological effect of skeletally retained radioelements has accumulated. In view of the greater radiosensitivity of infants to nuclear radiation, the global exposure involved, and the lifetime irradiation periods, it may well be that the appropriate MPC for evaluating the global Sr^{90} hazard should be 1/100 the occupational value. The MPC for Sr^{90} is based on comparison to the radium MPC, which, in turn, hinges on our experience with radium poisoning in human beings. Practically no data are available for radium retention in children and, in addition, very few radium-retention studies on human beings have been carried out over a period of 40 or 50 years.

7) In projecting their estimates of Sr^{90} retention through 1970, the authors make no allowance for additional nuclear tests. In view of the fact that the British will test weapons in the megaton range within a few months and the Soviets may overcome their continental proving ground limitation so that a Castle series of tests may be undertaken shortly, it seems naive to assume a vacuum in testing from 1956 to 1970.

In addition to these seven points, one should consider the role of concentration factors in fallout, the selectivity of global fallout, the possibility of different fallout patterns for bomb debris injected into the stratosphere at points other than the U.S. and U.S.S.R. test sites as well as the influence of different substrata on fallout phenomenology. Nor should one neglect the possibility of ecological upset owing to concentration of radioelements in nature.

Any meaningful evaluation of the Sr^{90} hazard must seek to assess the risk of excessive radiation exposure to the most radio-sensitive groups of the total population. Because of the global nature of the fallout, the problem of risk-evalua-

tion should be undertaken on an international basis. No governmental group within the United States should undertake to assume or calculate risks for peoples of foreign lands. The United Nations has established a committee to investigate the biological effects of nuclear fallout, and it is to be hoped that technical reports will be forthcoming soon. Then attention may be focused on weighing the probable risks of future bomb tests, and it may be possible to fix a limit to the annual testing of nuclear weapons to keep stratospheric pollution within safe limits.

It is salutary that the Atomic Energy Commission has sponsored such high-quality scientific research and even more hopeful that phases of this work are emerging from the classified category. Independent analyses of the problem, such as those appearing in the *Bulletin of the Atomic Scientists*, now rest on a more solid foundation of fact than was heretofore possible.

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19 February 1957

Although we share Ralph Lapp's concern for the seriousness of the Sr^{90} problem for the world population, we wish to dissent from some of his interpretations of our data.

1) We quite agree that momentarily the biological hazard is greatest for young children. We do not see how a discussion of the average concentration of Sr^{90} in adults is misleading when we give all the individual data, as well as the averages of 10-year-age intervals, and definitely conclude that "children have 3 to 4 times more strontium-90 per gram of calcium . . . than adults."

2) We did not conclude that the present data permit "careful evaluation of the biological hazard" in children. In fact, we made it clear that many more data are urgently needed. The important statistical quantities, of course, are the mean and the standard deviation.

3) We clearly pointed out that the present situation does not represent equilibrium but that reasonable predictions can be made of what the equilibrium situation may be. By examining the steps in the bomb-to-bone chain, we were able to conclude that the quantity of Sr^{90} in human bone is approximately that predicted from our knowledge of the total fallout and the fractionation factors in the chain. Actually, the time scale of importance is on the order of a year, and in this period the milk appears to be fairly well equilibrated with the soil. When milk is the major source of calcium in the diet of young children, the children will likewise approach a transient equilibrium.

4) The data on stillborns did not involve the average predicted for ultimate equilibrium.

5) We most emphatically did not present our data in maximum permissible concentrations for several reasons, not the least of which is the current debate among competent medical scientists on what this value should be. We reported all our data in absolute units of microcuries of Sr^{90} per gram of calcium. We discussed the data relative to the one official Sr^{90} level existing at the time we wrote the article—that is, the maximum permissible concentration for industrial workers stated in the *National Bureau of Standards Handbook No. 52*.

6) The setting of the maximum permissible concentration is not in our sphere of scientific competence. This was not one of our conclusions.

7) We could have calculated the average concentration of Sr^{90} in man in 1970 either by using the known number of atomic tests to date or by assuming some unknown arbitrary number. We chose the former and clearly stated our assumption. The point here was to show what will ultimately get into man from a known quantity of debris produced. It was not our intention to calculate how much might be present in man by 1970 assuming some grave political situation.

It is hoped that current experimental work in this laboratory and elsewhere will make it possible to provide information on some of the other problems which Lapp and others have raised. Although there will remain much area of debate, new data to be published shortly will place some further limits on the area of speculation. In reporting the laboratory data on this controversial and globally important subject, we have tried, and will continue to try, to present it as objectively as possible, so that the scientist-citizen such as Lapp may discuss the sociopolitical problem in as well informed a manner as possible.

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3 April 1957

Role of 5-Hydroxytryptamine in the Inflammatory Process

Benditt *et al.* (1) revealed that 5-hydroxytryptamine, as well as histamine and heparin, is present in mast cells. They also found that edema, following administration of egg white, is induced by liberation of 5-hydroxytryptamine from the mast cells and that histamine has a lesser role in the formation of

Table 1. Percentage of macrophages ingesting tubercle bacilli, strain BCG, after 1 hour's incubation.

Injection		Number of bacilli per monocytes				
Compound	Amt. ($\mu\text{g}/\text{ml}$)	0	1-2	3-5	6-10	10
Control		21	24	36	12	7
Histamine	0.10	20	29	34	15	2
Histamine	1.0	12	27	30	20	11
Histamine	10.0	12	25	18	27	18
Histamine	100.0	76	13	8	3	
Heparin	0.10	25	35	26	12	2
Heparin	1.0	24	35	24	14	3
Heparin	10.0	32	30	22	10	6
5-Hydroxytryptamine	0.1	19	30	31	10	10
5-Hydroxytryptamine	1.0	26	27	32	7	8
5-Hydroxytryptamine	10.0	24	29	37	8	2
5-Hydroxytryptamine	100.0		most of the cells disrupted			
48/80	0.1	17	27	36	15	5
48/80	1.0	26	30	36	2	6
48/80	10.0	25	25	40	4	6
48/80	100.0	30	27	35	6	2

edema. On the basis of these observations, Benditt *et al.* consider that 5-hydroxytryptamine participates in the defense mechanism of the inflammatory process.

The compound 48/80 (condensation product of *p*-methoxyphenethylmethylamine with formaldehyde) is considered to be the most potent of a large number of known liberators of histamine in the skin. If it is administered intradermally, 5-hydroxytryptamine does not equal the action of histamine or 48/80 calculated on the basis of weight as observed in skin reactions (hyperemia, edema, necrosis) or the local accumulation of intravenously injected dyes (Pentamin blue, trypan blue).

In our experiments, histamine, 48/80, or 5-hydroxytryptamine was dissolved in distilled water and applied on the previously depilated skin of albino rats (weight 100 g). Immediately afterward, India ink or trypan blue was injected intravenously into the animals. One hour later, the animals were killed, and we examined the intensity and size of the accumulation of India ink or trypan blue on the inside of the abdominal skin, which was removed. We found that if a 2-percent solution of histamine or 48/80 was rubbed for 1 minute on the skin, the local accumulation of India ink or trypan blue was of equal intensity, but only a minimal accumulation was observed following a similar application of a 2-percent dextran solution. While a 0.1 percent solution of histamine or 48/80 could not induce the phenomenon, a 0.1-percent solution of 5-hydroxytryptamine led to the local accumulation of India ink or trypan blue of an intensity equal to that induced by a 2-percent solution of histamine or 48/80.

In studying the role of histamine in the inflammatory process, we found (2) that monocytes revealed an increased

phagocytic activity under the influence of small amounts of histamine (1 to 10 $\mu\text{g}/\text{ml}$), but larger amounts of histamine (100 $\mu\text{g}/\text{ml}$) considerably reduced the phagocytic activity of these cells. Loos (3) showed that histamine increased phagocytosis of carbon particles by equine leucocytes *in vitro*. Rigdon (4) attributed a chemotactic action to the histamine, and Bloom (5) considered the histamine to be responsible for the migration of leucocytes into the area of inflammation in the tissues. Wolf (6) demonstrated a similar action *in vitro*, and Findlay (7) showed the same phenomenon *in vitro* and *in vivo*. These observations substantiate the opinion of Jancso (8) that histamine is a physiological activator of the reticuloendothelial system. We produced further experimental evidence (9) supporting Jancso's views.

Recent data published by Benditt *et al.* (1) suggest that a similar role could be played by 5-hydroxytryptamine. Both histamine and 5-hydroxytryptamine are built into the mast cells, which suffer a serious destruction when injury to the tissues occurs. According to Riley and West (10) and Fawcett (11), the destruction and regeneration of mast cells are processed simultaneously with the liberation and restoration of histamine, respectively. It is of further interest that the intensity of these phenomena is proportionate to the degree of the injury sustained.

We have investigated the effect of histamine, 5-hydroxytryptamine, heparin, and 48/80 (12) on the phagocytic activity of monocytes in order to ascertain whether a similar response could be detected on the action of these substances on surviving macrophages *in vitro*. Materials and methods were used as previously described (2). Monocytes were taken from the peritoneal cavity of

guinea pigs. Exudate, containing more than 90 percent of monocytes among the cellular elements, was induced by previous intraperitoneal injection of 0.1 mg of glycogen in saline solution. Washed tubercle bacilli (strain BCG) were added *in vitro* to the suspension of monocytes, and, 1 hour after incubation, phagocytized numbers of tubercle bacilli were counted in 100 monocytes on stained preparations (Table 1).

In the given experimental conditions, 1 $\mu\text{g}/\text{ml}$ and 10 $\mu\text{g}/\text{ml}$ of histamine increased phagocytosis of tubercle bacilli, while 100 $\mu\text{g}/\text{ml}$ inhibited the same phenomenon. 5-Hydroxytryptamine had no effect on the phagocytosis; however, 0.1 and 1 μg of heparin per milliliter did not influence phagocytosis of tubercle bacilli, but 100- $\mu\text{g}/\text{ml}$ quantities inhibited the ingestion of the bacilli; 48/80 did not at all influence the ingestion of tubercle bacilli.

As injury occurs to the organism, histamine and 5-hydroxytryptamine are liberated from the mast cells, but the two substances show a different behavior if their role is studied in the defense processes. 5-Hydroxytryptamine was found to be the most potent agent, inducing an accumulation of India ink or trypan blue at the site where they were administered percutaneously. These findings confirm those of Benditt *et al.* (1), who observed that a considerably smaller amount of 5-hydroxytryptamine than of histamine was necessary to provoke the same intensity of accumulation. In our experiments, not only a quantitative difference was found in the effect of the two substances on the accumulation, but a qualitative one was seen on the phagocytic activity of monocytes *in vitro*, for this activity was influenced by histamine but not by 5-hydroxytryptamine. It would appear that the action of histamine is more general on the reticuloendothelial system, while 5-hydroxytryptamine has no effect on the monocytes.

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References and Notes

1. E. P. Benditt, S. Bader, B. L. Kai, *Arch. Pathol.* 60, 104 (1956).
2. B. Gözsy and L. Kátó, *Can. J. Biochem. Phys.* 34, 571 (1956).
3. H. P. Loos, *Z. ges. expil. Med.* 75, 462 (1931).
4. R. H. Rigdon, *J. Lab. Clin. Med.* 27, 598 (1941).
5. W. Bloom, *Bull. Johns Hopkins Hosp.* 33, 185 (1922).
6. E. P. Wolf, *J. Exptl. Med.* 34, 375 (1921).
7. G. M. Findlay, *J. Pathol. Bacteriol.* 31, 633 (1928).
8. M. Jancsó, *Nature* 160, 227 (1947).
9. L. Kátó and B. Gözsy, *Am. J. Physiol.* 104, 296 (1956).
10. J. F. Riley and G. B. West, *J. Pathol. Bacteriol.* 69, 269 (1955).
11. W. Fawcett, *J. Exptl. Med.* 100, 217 (1954).
12. Compound 48/80 was provided by Burroughs

Wellcome and Co. through the courtesy of Edwin J. de Beer. Dextran was provided by Abbott Laboratories; molecular weight 79,400, low fraction, 28,300, high fraction 180,800. 5-Hydroxytryptamine was serotonin creatine sulfate (Nutritional Biochemical Co.). This work was partially aided by grants from the Ministry of Health of the Province of Quebec (Federal-Provincial Health Research Grants).

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Protection against X-irradiation by 3-Amino-1,2,4-triazole

Heim, Appleman, and Pyfrom (1) recently demonstrated that after intraperitoneal injection of 3-amino-1,2,4-triazole (AT) into rats, the liver and kidney catalase activity was sharply reduced. Our first conclusion, of course, was tentatively to consider this compound to be a catalase inhibitor. Since such radiation protectors as azide (2) and cyanide (2,3) have also been shown to inhibit catalase *in vitro* (4) and, at least in the case of azide, *in vivo* (5), it was decided to test AT also as a protective agent against ionizing radiation (6). Injection of a catalase inhibitor may appear to be paradoxical in at-

tempting to protect against irradiation lethality. However, one must consider such possible mechanisms as the formation of a catalase-inhibitor complex more radiation-stable than the uncomplexed catalase (7).

Table 1 indicates that intraperitoneal injection of AT before whole body x-irradiation rather consistently protects a large percentage of mice against 650 r of x-rays and significantly prolongs the survival of animals that receive 750 or 850 r of x-rays. (If all data shown are pooled for mice receiving 850 r alone, and for mice receiving AT followed by an 850-r dose, the Student's *t* value for the difference in survival time is 2.90, with a total population in each case of 59 mice killed. This represents $0.001 < P < .005$.) If administered before a 1700-r dose, or after any dose of x-rays, AT is without effect. Even if AT is administered as long as 24 hours before the irradiation, some prolongation of survival time is conferred. It might be mentioned that the doses of AT employed were well tolerated by the mice.

Even though AT *per se* has been found not to be an inhibitor of catalase (8), the possibility cannot be excluded

that a catalase mechanism is in some way relevant to the radiation protection, for a single injection of this compound will cause a 65-percent reduction in liver catalase activity as late as 24 hours after injection (8). The mechanism of the biological effects of AT is presently being further investigated.

After this work had been completed, a paper appeared by Friedberg (9), indicating no significant effect of AT on mortality rate after 934 r. His data do show, as do ours, prolongation of survival time.

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References and Notes

1. W. G. Heim, D. Appleman, H. T. Pyfrom, *Science* 122, 693 (1955).
2. Z. M. Bacq and A. Herve, *Brit. J. Radiol.* 24, 617 (1951).
3. Z. M. Bacq *et al.*, *Science* 111, 356 (1950).
4. H. Blaschko, *Biochem. J. (London)* 29, 2303 (1935); P. Rona, A. Fiegel, W. Nakahara, *Biochem. Z.* 160, 272 (1925).
5. R. N. Feinstein, unpublished data.
6. This work was performed under the auspices of the U.S. Atomic Energy Commission. We wish to express our thanks to T. M. Vial and the American Cyanamid Company for generous samples of technical grade 3-amino-1,2,4-triazole and to John H. Pomeroy and Carolyn A. Craig for its purification.
7. R. N. Feinstein, C. L. Butler, D. D. Hendley, *Science* 111, 149 (1950).
8. R. N. Feinstein, S. Berliner, F. O. Green, in preparation.
9. W. Friedberg, *Proc. Soc. Exptl. Biol. Med.* 93, 52 (1956).

11 February 1957

Use of Δ^4 -Cholestenone to Reduce the Level of Serum Cholesterol in Man

In 1953 Tomkins *et al.* (1) demonstrated that a single feeding of 4-cholestenone-3-one (cholestenone) to rats reduced the capacity of their livers to convert acetate to cholesterol. Soon after this observation was made, studies were initiated in our laboratory to test the effects of prolonged administration of cholestenone on the level of plasma cholesterol.

Dogs were fed 1 g of cholestenone every 8 hours for 17 days. In one dog, the concentration of plasma cholesterol fell from an initial value of 100 mg/100 ml to 70 mg on the eighth day of feeding, to 65 mg on the 12th day, and to 55 mg on the 17th day. In another dog, the levels of plasma cholesterol were 115 before the cholestenone feeding was begun and 75, 80, and 70, respectively, on the 8th, 12th, and 17th days of feeding.

Substantial reductions in the levels of plasma cholesterol were also observed in chickens that were fed Purina broiler

Table 1. Protection of mice by 3-amino-1,2,4-triazole (AT) against whole body x-irradiation.

Amino-triazole (mg/kg)	X-ray (r)	Order of treatment	Number of mice	30-day survivors (%)	Average survival time (days)*
<i>Experiment 1</i>					
0	450		10	90	9.0
2000	450	AT, x-ray	12	92	13.0
0	650		12	0	12.5
2000	650	AT, x-ray	10	70	15.7
0	850		12	0	8.9
2000	850	AT, x-ray	12	8	12.2
4000	0		11	100	
<i>Experiment 2</i>					
0	850		8	0	6.3
2250	850	AT, x-ray	12	8	9.7
2250	0		12	100	
<i>Experiment 3</i>					
0	850		11	0	11.5
1817	850	AT, x-ray	11	0	13.5
1817	850	x-ray, AT	11	0	11.0
0	1700		11	0	4.5
1817	1700	AT, x-ray	11	0	4.4
<i>Experiment 4</i>					
0	850		12	0	13.4
1817	850	AT, x-ray	12	17	13.3
1817	850	x-ray, AT	12	0	12.1
0	1700		11	0	4.0
1817	1700	AT, x-ray	12	0	4.5
<i>Experiment 5</i>					
0	650		16	19	13.9
2000	650	AT, x-ray	16	75	19.3
0	750		16	0	11.1
2000	750	AT, x-ray	13	0	13.6
0	850		16	0	10.6
2000	850	AT, x-ray	16	0	12.0
2000	0		16	100	

* Average survival time refers only to those animals that succumbed within the 30-day period.

chow to which had been added 1 percent cholestenone. In one bird, a 10-day feeding of this diet reduced the level of plasma cholesterol from 104 to 57 mg, and in another, a 16-day feeding period resulted in a fall in the cholesterol concentration of plasma from 131 to 58 mg/100 ml. Steinberg and Frederickson (2) have also shown that the feeding of 1 percent cholestenone to rats suppresses the incorporation of acetate- C^{14} into cholesterol by hepatic tissue and brings about a reduction in the levels of serum cholesterol.

Since the administration of cholestenone offered a means for reducing plasma cholesterol—which is regarded today as one of the parameters in the development of arteriosclerosis—we have carried out extensive studies on the fate of cholestenone in the body. In the rat it was shown, with the aid of cholestenone-4- C^{14} , that this steroid is converted to cholestan-3 β -ol (dihydrocholesterol) (3). More recently, we have observed that this conversion takes place by the time the C^{14} of the ingested cholestenone-4- C^{14} appears in thoracic duct lymph (4). An important observation made in connection with the prolonged feeding of cholestenone in birds is that the level of total sterols—in contrast to cholesterol level—is not reduced in plasma and that large amounts of cholestanol accumulate in plasma and other tissues (5). The prolonged feeding of cholestanol has been shown to induce arteriosclerosis in rabbits (6) and chickens (7). Because high levels of tissue cholestanol result from the feeding of cholestenone, one would therefore expect to find that the latter is also atherogenic when it is fed in large amounts.

Procedures that lower plasma cholesterol levels are eagerly being put to use in man today. In view of this, it is necessary to call attention to the dangers that may result from prolonged administration of large amounts of a steroid like cholestenone which is converted, in the animal body, to an arteriosclerosis-inducing sterol. Our studies (8) also bring out that it is important to know the level of total sterols in plasma, as well as that of cholesterol, when one is considering the feeding of large amounts of steroids to influence the course of arteriosclerosis in animals.

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References and Notes

1. G. M. Tomkins, H. Sheppard, I. L. Chaikoff, *J. Biol. Chem.* 203, 781 (1953).
2. D. Steinberg and D. S. Frederickson, *Ann. N.Y. Acad. Sci.* 64, 579 (1956).
3. F. M. Harold, S. Abraham, I. L. Chaikoff, *J. Biol. Chem.* 221, 435 (1956).

4. D. D. Chapman, H. H. Hernandez, I. L. Chaikoff, unpublished observations.
5. D. D. Chapman, C. W. Nichols, Jr., I. L. Chaikoff, unpublished observations.
6. C. W. Nichols, Jr., M. D. Siperstein, I. L. Chaikoff, *Proc. Soc. Exptl. Biol. Med.* 83, 756 (1953).
7. C. W. Nichols, Jr., S. Lindsay, I. L. Chaikoff, *ibid.* 89, 609 (1955).
8. These studies were aided by grants from the U.S. Public Health Service and the Alameda County (California) Heart Association.
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Uricolytic Activity of Purified Uricase in Two Human Beings

Recently, several methods for obtaining highly purified uricase have become available (1, 2). It was demonstrated (3), as had been shown with less pure enzyme (4), that parenteral administration of uricase could temporarily decrease serum uric acid levels in chickens. Unlike the earlier attempts, this time with much purer material, it was demonstrated in two laboratories that doses several times greater than those given the chickens, on a body-weight basis, had no anaphylactoid or other toxic properties when tested on small animals.

It was deemed reasonably safe to cautiously inoculate human beings with our purest enzymic preparation (2). To insure against bacterial infection from this preparation, the aqueous enzyme suspension was shaken for a few seconds with toluene. Samples were then inoculated into three guinea pigs and cultured aerobically and anaerobically. After 48 hours, when there was no evidence of bacterial growth and the animals appeared to be normal, the preparation was used. Toluene separated from the aqueous suspensions, and with care the enzyme was inoculated with very little hydrocarbon present. Relatively greater quantities of toluene in saline suspension were not toxic to mice (3, 5).

The first patient was a 55-year-old male (57 kg) with a long history of typical gouty arthritis, but who did not have an attack either just before or during the experimental period. He was put to bed and kept on a low purine diet during the course of the experiment. All urine was collected and analyzed for allantoin according to the method of Young and Conway (6). Serum uric acid levels were determined at various intervals according to Brown's method (7). A second patient, a 63-year-old male (71 kg) with no medical history of gout was treated the same way.

The uricase preparation was administered after the patients had been resting and had been on the low purine diet for more than 48 hours. The enzyme was

administered intravenously in small doses, and each successive dose was held back until it was observed that the preceding one was producing no unexpected reactions. The preparation administered contained 104 units (3) and 13.5 μ g of protein nitrogen per milliliter in suspension. (A unit of activity is the amount of enzyme required to break down 1 μ g of uric acid per minute at 37°C and pH 9.2 in a solution where the initial concentration of uric acid is 5 μ g/ml.

Figures 1 and 2 show the serum uric acid levels for each patient and the corresponding urinary allantoin excretions for the entire experimental period. The changes in allantoin output clearly demonstrate that following intravenous uricase injections man can convert uric acid to allantoin.

Normally, man excretes only that small quantity of allantoin which is ingested with his food. The *in vivo* uric acid breakdown was not as clearly demonstrated in either case. In each of these early experiments, it was not intended to administer a therapeutic dose of the enzyme, but simply to administer a quantity just sufficient to elicit a definite uricolytic effect. This was accomplished in both cases.

As was pointed out earlier (3), neither the lowering of serum uric acid level nor the measurement of allantoin formed

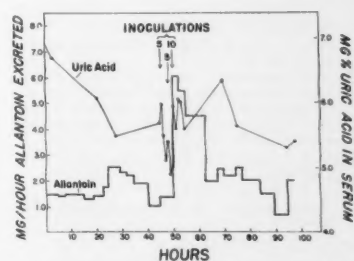


Fig. 1. This was a gouty patient whose serum uric acid levels were usually above 7.0 mg percent. The sharp decrease of uric acid level after the patient went on a low purine diet and the rapid rebound of the level after the initial drop following administration of uricase are striking. The numbers under "inoculations" represent milliliters of enzyme given.

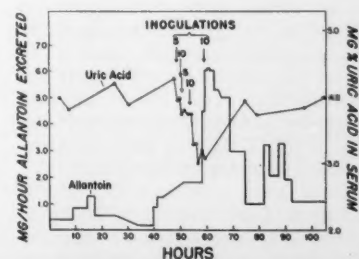


Fig. 2. Results on a normal male.

necessarily measures the uricolytic effect. In men, especially those who suffer from gout, there may be uric acid deposits. This reserve and normal endogenous and exogenous nucleic acid breakdown tend to maintain a constant serum uric acid level. Also, the breakdown of uric acid in blood does not necessarily lead to the quantitative formation of allantoin.

From the knowledge that even purer uricase preparations than that used here may be available (1) and that we are still far from using toxic doses, as demonstrated with animals, we are led to hope that the enzyme may yet be an adjunct in the treatment of gout and other pathological processes in which it may be necessary to clear the bloodstream of high uric acid concentration. In the rapidly developing fields of chemotherapy and radiotherapy, there is a potential need for a means of removal of excess uric acid which accumulates from the nuclear breakdown of malignant cells.

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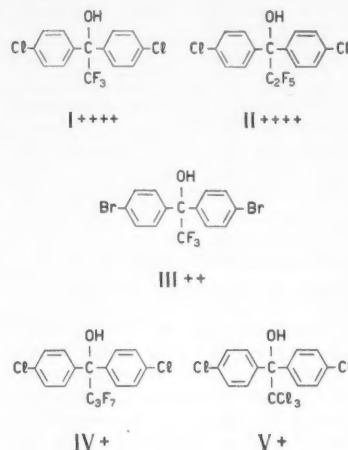
References and Notes

1. H. R. Mahler, G. Hübscher, H. Baum, *J. Biol. Chem.* 216, 625 (1955).
2. M. London and P. B. Hudson, *Biochim. et Biophys. Acta* 21, 290 (1956).
3. M. London and A. L. Finkle, *J. Urol.* 76, 168 (1956).
4. E. H. Oppenheimer and H. G. Kunkel, *Bull. Johns Hopkins Hosp.* 73, 40 (1943); K. I. Altman, K. Smull, E. S. G. Barron, *Arch. Biochem.* 21, 158 (1949).
5. This investigation was supported by a grant from the Damon Runyon Memorial Fund and by a grant-in-aid from the American Cancer Society, upon recommendation of the Committee on Growth, National Research Council.
6. E. G. Young and C. F. Conway, *J. Biol. Chem.* 142, 839 (1942).
7. H. Brown, *ibid.* 158, 601 (1945).
- * Present address: North Shore Hospital, Manhasset, N.Y.
- 10 January 1957

Prevention of Oviposition in the Housefly through Tarsal Contact Agents

In our attempt to find ways of fighting insects, alternative to the use of contact insecticides, we have sought contact agents that would, even in sublethal doses, reduce significantly oviposition in houseflies. Among the substances tested, di-(*p*-chlorophenyl)-trifluoromethylcarbinol (I) and di-(*p*-chlorophenyl)-pentafluoroethylcarbinol (II) were outstanding. The corresponding dibromo compound (III), as well as di-(*p*-chlorophenyl)-heptafluoropropylcarbinol (IV), showed lower activity. If the chlorine atoms in I are replaced by methyl or methoxyl groups, the activity disappears completely, while replacement of the fluorine atoms in I by chlorine, which

yields di-(*p*-chlorophenyl)-trichloromethylcarbinol (V) (DTMC), results in low activity. Di-(*p*-chlorophenyl)-dichloromethylcarbinol and DMC were completely inactive.



All of these compounds, which have become available only recently (1, 2) and have also shown interesting biological properties in other respects (2, 3), reduce, delay, or prevent oviposition in houseflies upon tarsal contact, when they are applied to females prior to feeding with milk.

Since compounds I (2) and II possess some slight contact toxicity, their oviposition-inhibiting properties are best demonstrated on a highly polyvalent resistant strain of houseflies. An extremely resistant Swiss strain (K_1) of *Musca domestica* L. (4) whose females are not at all affected by compounds I and II even at continuous exposure, has proved very valuable in these experiments, which have also employed a normal Swiss strain of *Musca domestica* L. and a normal and highly DDT-resistant local strain of *Musca vicina* Macq.

In general, 3-day-old females were taken from cages with mixed populations (thus fertilization was ensured) fed water and sugar only (5). They were then treated with compound I or II, introduced with equal numbers of untreated males into new cages, and fed with milk. Results with compounds I and II are summarized in Table 1; controls laid eggs normally.

It is thus possible to counteract the influence of continuous feeding with milk by continuous exposure to compound I or II. Smaller quantities or shorter exposure (with method 4) than those shown in Table 1 delay or drastically reduce the laying of eggs, while continuous feeding of milk, under the conditions of experiments 3 and 4 (Table 1), overcompensates the effect of compounds I and II.

On dissection of females that had

Table 1. Effect on oviposition of treatment of houseflies with compounds I and II. Three-day-old females of a highly resistant strain (K_1) of *Musca domestica* L. that had been fed only water and sugar were used. Milk was offered either daily (beginning on the fourth day of life) or only on the fourth day of life.

Expt. No. and mode of application of compounds	Milk offered	Oviposition during entire lifetime	
		Compound I	Compound II
1. Feeding in milk (0.01%)	Daily (treated)	Normal	Normal
2. Exposure to vapor	4th day	Normal	Normal
3. Topical*	4th day	None	None
4. Tarsal contact for 30 min†	4th day	None	Negligible
5. Continuous exposure‡	Daily	Very low	None

* One microgram in acetone per female.

† Females were exposed for 30 minutes to a deposit of 1 g/m² in petri dishes and then placed in the cages with the males.

‡ Filter paper of area equal to the area of one side of the cage was impregnated with 1.5 g/m² and hung in the center of the cage. (Crowding of flies in cages, which results in the covering of the compounds on the filter paper by feces, should be avoided in these experiments.)

been continuously exposed to compound I or II (method 5), it was found that motile spermatozoa were abundant in the spermathecae and that ovaries developed normally (same length as in control flies on milk) and contained eggs. We have thus a case of "forced retention" (6).

The only data on the effect of chlorinated hydrocarbons on oviposition that have come to our knowledge are the following: Dieldrin in sublethal doses increases the reproductive potential in houseflies and *Drosophila melanogaster* Meig. (7), while DDT has a similar effect in *Metatetranychus ulmi* Koch (8). In *Drosophila* (9), DDT is reported to slightly reduce oviposition (10).

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References and Notes

1. E. D. Bergmann et al., *Nature* 176, 266 (1955); A. Kaluszynski, S. Reuter, E. D. Bergmann, *J. Am. Chem. Soc.* 77, 4164 (1955).
2. S. Reuter and K. R. S. Ascher, *Experientia* 12, 316 (1956).
3. S. Reuter et al., *Riv. parassitol.* 17, 125 (1956); A. S. Tahori, *J. Econ. Entomol.* 48, 638 (1955); S. Cohen and A. S. Tahori, *J. Agric. Food Chem.*, in press.
4. This strain was obtained through the courtesy of C. Kocher, J. R. Geigy S. A., Basel, Switzerland. For properties of this strain, see K. R. S. Ascher and C. Kocher, *Experientia* 10, 465 (1954).
5. Great care was taken to prevent protein ingestion during the first 3 days owing to feed-

- ing on dead flies, a source of error in oviposition studies recently examined; see K. R. S. Ascher and Z. H. Levinson, *Riv. parasitol.* 17, 217 (1956).
6. P. A. Woke, *Ann. Entomol. Soc. Amer.* 48, 39 (1955).
 7. CDS Summary of investigations, January-June 1955, No. 8, p. 43; S. E. D. Afifi and H. Knutson, *J. Econ. Entomol.* 49, 310 (1956); H. Knutson, *Ann. Entomol. Soc. Amer.* 48, 35 (1955).
 8. H. J. Hueck, dissertation, University of Leiden, 1953, pp. 1-148; H. J. Hueck *et al.*, *Physiol. comparata et Oecol.* 2, 371 (1952).
 9. F. Tattersfield and J. R. Kerridge, *Ann. Appl. Biol.* 43, 630 (1955).
 10. I wish to express my thanks to my colleague S. Reuter for the majority of compounds tested, and to A. Ben-Shmuel and D. Roch for excellent technical help.
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7 February 1957

Heat Inactivation of Catalase in Deuterium Oxide

We have measured the kinetics of heat inactivation of the enzyme catalase in H_2O and D_2O over a range of temperatures. The results show a considerable difference in both the heat and the entropy of activation, both being higher for heating in D_2O .

The enzyme (1) was dissolved in 0.05M phosphate buffer, made up in either H_2O or D_2O (>99.6 per cent) at pH 7.0 in H_2O . The D_2O buffer read 6.85 on the pH meter (2). The concentration of catalase during heating was 300 $\mu g/ml$. At appropriate intervals, 0.1-ml samples were taken, diluted to 15 $\mu g/ml$ in buffer made in H_2O , and assayed by observing the breakdown of H_2O_2 by measurements of optical density at 2300 Å in a Beckman model DU spectrophotometer (3). The D_2O concentration during assay was 1.4 percent. Standing in D_2O buffer for periods up to 2 weeks at 8°C had no measurable effect on the rate of subsequent inactivation in D_2O or on the absolute enzymatic activity as compared with fresh samples in H_2O .

The inactivation curves followed first-order kinetics within the precision of the data, with reaction times from a few seconds to several hours. From the observed rate constants, the free energies of activation were calculated from the theory of absolute reaction rates (4) according to the equation

$$k = \frac{kT}{h} e^{-\Delta F^\ddagger/RT}$$

Figure 1 shows the temperature dependence of the free energy of activation (ΔF^\ddagger). From the relation

$$\Delta F^\ddagger = \Delta H^\ddagger - T\Delta S^\ddagger$$

we find, for heating in H_2O , $\Delta H^\ddagger = 87$ kcal/mole and $\Delta S^\ddagger = 191$ cal/mole · deg,

and for heating in D_2O , $\Delta H^\ddagger = 145$ kcal/mole, and $\Delta S^\ddagger = 360$ cal/mole · deg.

Wiberg (5) and Morowitz and Brown (6) have recently reviewed the effect of deuterium on reaction rates. Since the zero-point energy of a covalent bond to deuterium is lower than that of the corresponding one to hydrogen by about 1.2 to 1.5 kcal/mole (because of the greater mass and consequent lower frequency), reactions which involve breaking such bonds are usually slower in D_2O , and deuterated compounds in general react more slowly than hydrogenated ones. Enzymatically catalyzed reactions have been observed to go both faster and slower in D_2O , and some of the reports are conflicting. Macht and Bryan (7) report a "noticeable acceleration" of the action of catalase on H_2O_2 in 0.05- to 1.0-percent D_2O , whereas Fox (8) reports no change in 1-percent D_2O . Our results tend to confirm Fox, although it is possible that a change of a few percent may have been unnoticed.

Caldwell, Doebbling, and Manion (9) reported that pancreatic amylase denatured more rapidly at 25°C in D_2O than in water, whereas Fox (8) reported no difference in the daily loss of catalase activity between D_2O and H_2O . It seems likely that neither of these cases represents thermal inactivation of the kind observed here. We found loss of catalase activity in H_2O at 25°C and 37°C to be much more rapid than consistent with the higher temperature data, and we suspect that bacterial growth was the cause. Extrapolation of the curve in Fig. 1 would yield a time of about 10 years at 25°C, for the same reaction in H_2O .

Morowitz and Chapman (10) reported that deuterium substitutes rapidly (within 20 minutes) in all bonds of proteins except C—H. Linderström-Lang (11) found that in some proteins there is a continued slower exchange following the initial rapid one. Our evidence suggests no further effect on heat stability of catalase between about 1/2 hour and 2 weeks.

The mechanism of thermal inactivation of enzymes is still obscure, although it is presumably closely related, if not identical, to denaturation. The high values of the heat and entropy of activation observed here are typical of enzyme inactivations and have suggested a process involving the breaking of a number of weak interchain hydrogen bonds, with accompanying high entropy changes as the molecule becomes more disordered (12). It may be expected that deuterium bonds are related to hydrogen bonds qualitatively as the respective covalent bonds, and that they will be somewhat stronger. It is not surprising, therefore, to find ΔH^\ddagger higher for inactivation in

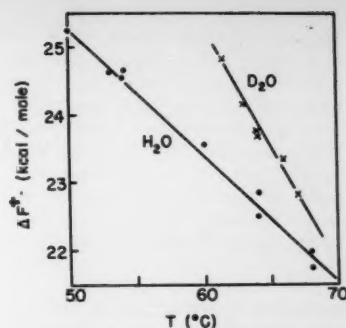


Fig. 1. The free energy of activation (ΔF^\ddagger) for inactivation of catalase in H_2O and D_2O at various temperatures. The lines represent the equation $\Delta F^\ddagger = \Delta H^\ddagger - T\Delta S^\ddagger$, where ΔH^\ddagger and ΔS^\ddagger are the heat and entropy of activation, respectively. For H_2O , $\Delta H^\ddagger = 87$ kcal/mole, $\Delta S^\ddagger = 191$ cal/mole · deg; for D_2O , $\Delta H^\ddagger = 145$ kcal/mole, $\Delta S^\ddagger = 360$ cal/mole · deg.

D_2O . Further, since the vibrational energy levels of a deuterium bond are more closely spaced, the partition functions are affected, and thereby the entropy terms are expected to be changed in the free energies of reactants, products, and activated complex. It is difficult, however, to predict a priori the effect of this on the ΔS^\ddagger of the inactivation process, except to say that it is likely to be different (13).

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References and Notes

1. Crystalline beef liver catalase, lyophilized, Worthington Biochemical Corp., Freehold, N.J.
2. Beckman model G, glass (No. 270) and Calomel (No. 290) electrodes.
3. R. F. Beers and I. W. Sizer, *J. Biol. Chem.* 195, 133 (1952).
4. S. Glasstone, K. J. Laidler, H. Eyring, *The Theory of Rate Processes* (McGraw-Hill, New York, 1941).
5. K. B. Wiberg, *Chem. Revs.* 55, 713 (1955).
6. H. J. Morowitz and L. M. Brown, "The biological effects of deuterium compounds," *Natl. Bur. Standards (U.S.) Rept.* 2179 (1953).
7. D. I. Macht and H. F. Bryan, *Proc. Soc. Exptl. Biol. Med.* 34, 190 (1936).
8. D. L. Fox, *J. Cellular Comp. Physiol.* 6, 405 (1935).
9. M. L. Caldwell, S. E. Doebbling, S. Manion, *J. Am. Chem. Soc.* 58, 84 (1936).
10. H. J. Morowitz and M. W. Chapman, *Arch. Biochem. and Biophys.* 56, 110 (1955).
11. K. Linderström-Lang, *Soc. Biol. Chemists India* 191 (1955); "Symposium on peptide chemistry," *Chem. Soc. London Spec. Publ.* No. 2 (1955).
12. A. E. Stearn, *Advances in Enzymol.* 9, 25 (1949).
13. We thank H. J. Morowitz, for suggestions concerning, and discussions of, these experiments, and E. M. McKelvey and R. M. Gibson, who performed some of the preliminary experiments.

1 March 1957

Book Reviews

Biochemical Individuality. The basis for the genetotrophic concept. Roger J. Williams. Wiley, New York; Chapman & Hall, London, 1956. 214 pp. Illus. \$5.75.

The author of this stimulating monograph has devoted a major portion of his career to the development of the concept of biochemical individuality and to a demonstration of the validity of its role in a proper understanding of man and his disorders. In *Biochemical Individuality*, Roger Williams has extracted from a wealth of information, obtained by himself and others, a careful development of his thesis and its significance to various aspects of biological and medical science. He has presented this material in a way which is both succinct and interesting.

The concept of biochemical individuality holds that, just as each human being is unique from the point of view of certain physical or personality characteristics, he also possesses an individuality, to a large extent genetically determined, in terms of the biochemical and metabolic patterns within him. Although this concept may in former years have had only academic or speculative value, in recent times chemical technology and biochemical understanding have advanced to the point where its validity can be demonstrated and a wide variety of chemical profiles can be obtained. The development of paper chromatography and of isotopic tracer techniques and the great advances in the knowledge of intermediary metabolism, which have all taken place within this generation, have made possible biochemical characterizations of a high degree of relevance and resolution.

Williams discusses the genetic bases of biochemical individuality in a sophisticated manner, with some reference to the recent interest in microbial genetics. He briefly reviews the variances and anomalies in gross anatomy along with a number of pertinent illustrations and passes quickly to biochemical deviation, which he develops and illustrates in considerable detail, with separate chapters devoted to individuality in composition, enzymic patterns, endocrine activity, excretion patterns, nutrition, and drug action.

The monograph concludes with three provocative and engaging chapters on the implications of biochemical individuality for the biological sciences, for medical and dental research, and for advances in psychiatry. Even though one may disagree with the occasional choice of particular examples to illustrate these implications, one cannot deny that the concept of individuality is a refreshingly new departure from the traditional "unity of biochemistry," in which not only all men but even all cells are biochemically equal. The field of biochemical individuality is one that deserves all the interest and much of the hope which Williams has aroused for it.

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Education in the U.S.A. A comparative study. W. Kenneth Richmond. Philosophical Library, New York, 1956. 227 pp. \$4.50.

No use trying to write a book about a foreign country, they say, if you stay in it longer than a week and less than a lifetime. Kenneth Richmond's first-hand acquaintance with the U.S.A. clearly falls within these limits. I cannot cite any textual authority, but my impression is that he spent some 12 months here as a visiting teacher, on furlough from his regular job as lecturer in education at the University of Glasgow. I myself—an Englishman who has lived in this country, on and off, for upward of 10 years—am presumably in no better case. Certainly, with the passage of time, one's early judgments come to seem absurdly superficial if not outrageously biased. Even so, I am willing to venture the opinion that *Education in the U.S.A.* would take some beating, within the compass of a couple of hundred pages, as a fair and illuminating study of its complex subject.

Kenneth Richmond traveled widely, read deeply, and observed acutely. In the one area of American education with which I can claim any personal familiarity, he makes a few errors of fact and judgment, but they do not distort the accuracy of his picture. He is properly

diffident in face of the dangers of generalizing about so disparate a collection of phenomena as education in the United States, but he is right in insisting that, beneath the surface, they present "an unmistakable likeness." Americans are fond of descanting on the diversity of their educational system, just as they are highly conscious, and proud, of local variations in other aspects of their national life. In so doing, I think, they underestimate the unity that underlies the diversity. It is only natural that it should be more evident to a foreigner, who is inevitably struck by those common features of the whole system that distinguish it from his own. Richmond finds this differentia in "Americanism," which he says "has a special significance for anyone wishing to understand the forces at work beneath the surface of the educational system of the sub-continent, since it provides the one clue by which the system's bewildering diversity can be reduced to any kind of unity."

Another British observer of American education recently remarked: "The educational systems of all countries develop gradually in response to characteristics peculiar to the local environment. Whether the results achieved under the system are satisfactory or not becomes an argument of quite different character from that which springs from international comparisons." Although Richmond calls his book "a comparative study," he is, in my view, successful in interpreting American education precisely because he understands that it has developed, and is still developing, in response to distinctively American values. He recognizes that these values have their roots in geography, climate, and history and, above all, in a sense of national mission—all of which set the United States of America apart from the older countries of the West. An Englishman (or, say, a Dutchman) understands, and shares, the broad democratic ideals that inspired the American Revolution; he has much greater difficulty in appreciating the peculiarly American attitudes that played an equal part in that movement and have continued to mold American life down to the present day—what may be summarized as "the frontier tradition" and the belief in "the American Way of Life" as something unique and providential. Americanism is all but incomprehensible to Europeans, just as it renders the evolutionary democracies of Western Europe a mystery to Americans.

Because Richmond has grasped this situation, his chapters on "Education in Americanism" and "The American high school: dream and reality" are the most valuable in the book. He is remarkably sympathetic toward the American educational ideal and apparently optimistic about the possibility of reconciling what

he calls the Jeffersonian and Jacksonian viewpoints. When he comes to "Higher learning," however, he shows himself painfully aware of the difficulties of reconciliation. He is convinced that American public opinion will never stand for a system designed to educate an "intellectual elite." But he asks the pertinent question whether "full-time further education" (that is, education beyond the high school) and "university education" are necessarily one and the same process. This old question of quantity versus quality is the unsolved problem of American education. How can we provide equality of educational opportunity without sacrificing the leaven that leaveneth the lump? With all his tact and imagination, Richmond's treatment of this problem is forthright enough to make his book worth while for Americans as well as for his own countrymen, for whom it was primarily intended.

A small point perhaps, but as a proof-reading job the book is no credit to British publishing.

F. L. WORMALD
Association of American Colleges

Advances in Genetics. vol. VIII. M. Demerec, Ed. Academic Press, New York, 1956. 402 pp. Illus. \$9.

This latest volume in a well-known series contains eight articles by ten authors and deals with the usual diversity of topics: mutations in plants; population genetics of *Gilia*; chromosome re-patterning and adaptation; genetics of flax, bees, ladybeetles, and sheep; and the cytogenetics of the tomato.

As in previous volumes, the articles, with few exceptions, deal with the total or general genetics of specific kinds of organisms. This arrangement is both an advantage and a disadvantage. It is an advantage to the investigator who wishes to find all the facts he can about the genetics of bees, beetles, barley, and toads, and to the teacher who is searching for apt examples of genetic phenomena beyond the often quoted textbook cases. It is a disadvantage to the student of heredity who is looking for competent reviews of the scientific issues of current interest in genetics. He will have to seek elsewhere.

The greatest single shortcoming of the eight volumes appears to be in the use of "advances" in the title. While genetics does advance by the accumulation of facts and the naming of genes, these advances must always be secondary to the improvements in concepts and interpretations based on the facts. If a person, not familiar with the nature of these volumes, were to come upon the title in a library file, search out the volumes, and examine the contents, he might go away

with the impression that genetics advances only by discovering new facts and miss the idea that genetics advances by exploring issues.

EARL L. GREEN
Roscoe B. Jackson Memorial Laboratory

Principles of Fungicidal Action. vol. 30 of *New Series of Plant Science Books*. James Horsfall. Chronica Botanica, Waltham, Mass.; Hafner, New York, 1956. 279 pp. Illus. \$6.50.

The study which relates man's fight against fungi and mildew, like all divisions of science, has advanced very rapidly in the last decade. This book, compiled at the rate of a chapter a week while the author was on sabbatical leave at the University of California during 1955, serves to bring the academic and applied microbiological devotee up to date on our present knowledge of mechanisms of fungitoxicity. Of the 678 references in the bibliography, 52 percent have been published since 1945, the date of James Horsfall's first publication on this subject. The treatise differs from the run-of-the-mill scientific compilations, since, as is pointed out by the author, the researches of his friends served as the source of light; Horsfall "merely produced the design for the shadow." This shadow of the compiler is cast throughout each chapter by the folksy way in which a very involved mechanism of action may be described, by the idiomatic expressions which are interspersed, and by the author's metaphorical description of fungus cells and components.

If your interests center around the composition of a fungus symphony and the effects which may be wrought upon this orchestra merely by a squeaky metabolic clarinet, these chapters are recommended for your further attention. A bonus, consisting of the author's opinions, questions, and suggestions for further research, is to be found in almost every chapter. Because of the manner in which the technical aspects of this microbiological field are presented, and because the reading of this volume accentuates the presence of gaps in our knowledge of this field, *Principles of Fungicidal Action* should prove of interest and value to those allied with this specialty as well as to academicians in both university and industrial life.

In the opening pages of this book, Horsfall acquaints the reader with landmarks in the history and development of fungicides. Appropriate definitions and necessary background information are found in the following two chapters, which are concerned with the appraising and the measuring of fungicidal and protective action of chemicals. The

various theories which attempt to answer such questions as how a chemical becomes available to the fungus and how it is mobilized so that its toxicity may be exerted are next discussed. The author hazards the guess that 75 percent of the reactions operative in fungitoxic mechanisms occur inside the cell; therefore, the important principle of fungicidal action—namely, permeation and penetration—is treated separately, in chapter 5.

The remaining ten chapters of the book contain discussions of the disruptive disturbances imposed by chemicals upon the fungus cell. These are divided, generally, into physical and chemical interferences. Under physical influences caused by various fungicides are included effects upon cellular structures, mitosis, spindle formation, chromosomal division, and conidial production. Chemical disruptions attributable to fungicides include such effects as those on enzymes, respiration, pigmentation, metabolites, and dormancy. In an entire chapter, importance of mineral nutrition to the well-being of the fungus is discussed in relation to the importance of chelation as a possible mechanism of fungitoxicity.

Discussions, in five chapters, contain background information in which the organic chemist, faculty adviser, or research director may find the appropriate clue to synthesize, or have synthesized, the best fungicide. These chapters are entitled: "Action of metals," "Action of sulfur," "Action of organic sulfur compounds," "Action of quinones and other ketones," and "Action of heterocyclic compounds."

The author's enthusiasm for the new frontier in plant pathology—namely, chemotherapy—is evidenced by his introduction to this subject in the last chapter of the book.

HAROLD G. SHIRK
*National Academy of Sciences—
National Research Council*

Principles of Guided Missile Design. *Aerodynamics, Propulsion, Structures and Design Practice.* E. Arthur Bonney, Maurice J. Zucrow, and Carl W. Besserer. Van Nostrand, Princeton, N. J., 1956. 595 pp. Illus. \$10.

This book is aimed at those individuals who may be interested in, or are at present directly working in, the guided-missile field. The organization of each section is of such a nature that the material presented can be readily understood by those who may themselves be untrained specialists. As a consequence of this objective, each section contains a large amount of general information in addition to the presentation of the fun-

damental principles usually associated with each subject.

E. A. Bonney, in writing the "Aerodynamics" section, limits himself to discussion of the supersonic speed range. This limitation is based on his assumption that, in the guided-missile field, the supersonic speed range is the only one of practical importance. Encompassing such topics as atmospheric conditions, shock and expansion waves, missile configurations, and static and dynamic stability, this particular section is of a non-mathematical nature.

"Propulsion," by M. J. Zucrow, is directed toward the establishment of the fundamental principles governing the internal-flow characteristics of power plants employed in guided missiles. Discussing such topics as the gas-dynamic equations, nozzles, diffusers, and various classes of engines, this section does at times have an overabundance of mathematical equations. However, no sacrifice has been made in the explanation of important concepts.

Design problems resulting from flight loads, environmental conditions, and reliability requirements are discussed in "Structures and design practice," by C. W. Besserer. Chapters outlining the principles of packaging engineering and component and composite design are also included. The title of this particular section is somewhat misleading in that the word *structures* is not employed in its more usual sense but is meant to imply "structural materials."

All three sections are accompanied by extensive references for those who wish to make further investigation of any subject.

In short, this is a well-written and easily read book—a definite necessity for those engaged in guided-missile design.

ROBERT DUFFY
Rensselaer Polytechnic Institute

New Books

Tranquilizing Drugs. A symposium held under the auspices of the American Association for the Advancement of Science in cooperation with the American Psychiatric Association and the American Physiological Society at the AAAS Atlanta, Ga., meeting, 27–28 Dec. 1955. Publ. No. 46. Harold E. Himwich, Ed. American Association for the Advancement of Science, Washington, D.C., 1957. 197 pp. \$5; \$4.50, AAAS members.

The Modern Universe. Raymond A. Lyttleton. Harper, New York, 1957. 207 pp. \$3.

Geologie Sedimentaire. Les series marines. Augustin Lombard. Masson, Paris; Vaillant-Carmanne, Liege, 1956. 722 pp. F. 11,000.

Nature's Guardians, Your Career in Conservation. Messner, New York, 1957. 192 pp. \$3.50.

Human Factors in Air Transportation. Occupational health and safety. Ross A. McFarland. McGraw-Hill, New York, 1953. 830 pp.

When Doctors Meet Reporters. A frank discussion by science writers and physicians of the controversy between the press and the medical profession. Compiled by Hillier Kriegbaum, from the record of a series of conferences sponsored by the Josiah Macy, Jr., Foundation. Published for the foundation by New York University Press, New York, 1957. 119 pp. \$2.50.

Optics. The science of vision. Vasco Ronchi. Translated from the Italian and revised by Edward Rosen. New York University Press, New York, 1957. 360 pp. \$10.

Practical Applications of Engineering Soil Maps. Engineering Soil Survey of New Jersey, Rept. No. 22. William W. Holman, Robert K. McCormack, James P. Minard, Alfred R. Jumikis. Rutgers University, New Brunswick, N.J., 1957. 113 pp. \$3.

Cold Injury. Transactions of the fourth conference 7–9 Nov. 1955, Princeton, N.J. M. Irene Ferrer, Ed. Josiah Macy, Jr., Foundation, New York, 1956. 371 pp. \$5.95.

Investigation of Virus Diseases of Brascia Crops. Agricultural Research Council Rept. Ser. No. 14. L. Broadbent. Cambridge University Press, New York, 1957. 94 pp. \$3.

John Muir, Father of Our National Parks. Charles Norman. Messner, New York, 191 pp. \$2.95.

Coal Science. Aspects of coal constitution. D. W. Van Krevelen and J. Schuyer. Elsevier, New York, 1957 (order from Van Nostrand, Princeton, N.J.), 352 pp. \$9.50.

Meat Hygiene. WHO Monograph Ser. No. 33. World Health Organization, Geneva, 1957 (order from Columbia University Press, New York). 511 pp. \$10.

Gestation. Transactions of the third conference 6–8 Mar. 1956, Princeton, N.J. Claude A. Villee, Ed. Josiah Macy, Jr., Foundation, New York, 1957. 253 pp. \$4.75.

A Naturalist in Palestine. Victor Howells. Philosophical Library, New York, 1957. 180 pp. \$6.

Butterflies. E. B. Ford. Collins, London, ed. 3, 1957 (order from Macmillan, New York). 368 pp. \$6.

The Population of Jamaica. George W. Roberts. Published for the Conservation Foundation at Cambridge University Press, New York, 1957. 356 pp. \$7.50.

The Physiology of Reproduction in Fungi. Cambridge Monographs in Experimental Biology No. 6. Lilian E. Hawker. Cambridge University Press, New York, 1957. 128 pp. \$3.

Treatise on Invertebrate Paleontology. pt. L. Mollusca 4, Cephalopoda, Ammonoidea. Raymond C. Moore, Ed. Geological Society of America and University of Kansas Press, 1957 (order from the Geological Society of America, 419 W. 117 St., New York 27). 490 pp.

The Defect Solid State. T. J. Gray, D. P. Detwiler, D. E. Rase, W. G. Lawrence, R. R. West, T. J. Jennings. Interscience, New York, 1957. 511 pp. \$11.

The Electrical Production of Music. Alan Douglas. Philosophical Library, New York, 1957. 223 pp. \$12.

Television Engineering, Principles and Practice. vol. 3. Waveform Generation. BBC Engineering Training Manuals. S. W. Amos and D. C. Birkinshaw. Iliffe, London; Philosophical Library, New York, 1957. 226 pp. \$15.

Television Receiving Equipment. W. T. Cocking. Iliffe, London; Philosophical Library, New York, ed. 4, 1957. 454 pp. \$15.

Modern Chemistry for the Engineer and Scientist. G. Ross Robertson. McGraw-Hill, New York, 1957. 442 pp. \$9.50.

Automation: Its Purpose and Future. Magnus Pyke. Philosophical Library, New York, 1957. 191 pp. \$10.

Emotional Illness: How Families Can Help. Karl R. Beutner and Nathan G. Hale, Jr. Putnam, New York, 1957. 158 pp. \$2.75.

The Water Relations of Terrestrial Arthropods. Cambridge Monographs in Experimental Biology No. 5. E. B. Edney. Cambridge University Press, New York, 1957. 109 pp. \$3.

Fleas, Flukes and Cuckoos. A study of bird parasites. Miriam Rothschild and Theresa Clay. Macmillan, New York, 1957. 305 pp. \$5.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, but to the publisher or agency sponsoring the publication.)

Atomic Energy Commission, Twenty-first Semiannual Report. U.S. Atomic Energy Commission, Washington, 1957. (order from Supt. of Documents, GPO, Washington 25). 396 pp.

Research in Industrial Education, Summaries of Studies 1930–1955. Vocational Division Bull. No. 264. Trade and Industrial Series No. 65. U.S. Department of Health, Education, and Welfare, Office of Education, Washington, 1957 (order from Supt. of Documents, GPO, Washington 25). 527 pp. \$1.75.

Cephalochordata. John Murray Expedition 1933–34. Scientific Reports, vol. X, No. 3, 8 pp. 6s.; *Variation in the Western Zosteropidae (Aves).* Bulletin of the British Museum (Natural History), Zoology, vol. 4, No. 7. R. E. Moreau. 135 pp. 35s.; *Studies on the Structure and Taxonomy of Bulinus jousseaumei (Dautzenberg).* Bulletin of the British Museum (Natural History), Zoology, vol. 5, No. 1. C. A. Wright. 29 pp. 10s. British Museum (Natural History) London, 1957.

Virus and Viruslike Diseases of Stone Fruits in Utah. A handbook for their identification and control. Bull. 384. B. L. Richards and L. C. Cochran. Utah Agricultural Experiment Station, Division of Agricultural Sciences and Utah Agricultural Experiment Station, Salt Lake City, 1957. 130 pp. \$1.50.

The Student's Role in College Policy-Making. A report prepared by Harry H. Lunn, Jr., for the Commission on Student Personnel of the American Council on Education. American Council on Education, Washington, 1957. 100 pp. \$1.

Meetings and Societies

Biological Sciences

The executive committee of the International Union of Biological Sciences (IUBS) met, 29-30 Oct. 1956, at the Centre Nationale de la Recherche Scientifique, Gif-sur-Yvette (near Paris). The members of the committee were comfortably housed in the Château de Gif, which is now the guest house of the Centre. The meetings were also held in the château. Those present were S. Hörstadius (Sweden), president of the Union; R. E. Cleland (United States); G. Montalenti (Italy); R. Ulrich and P. Chouard (France); J. Lanjouw (Holland); E. Handschin (Switzerland); A. A. Miles (England); B. Rensch (Germany); and J. Rousseau (Canada).

It was announced that six countries, including the United States, have agreed to raise their annual contribution to the union; the yearly increase totals about \$3300. Several other countries are expected to follow suit. A grant of 5000 crowns from a Swedish firm was also announced, and plans were laid to secure comparable grants from similar sources in other countries. A supplemental allocation of \$5500 from the International Council of Scientific Unions (ICSU), to be added to the \$19,500 already allotted for the scientific program of IUBS, was reported.

Progress was reported in the formation of the bureaux of two new liaison sections, one of biochemistry, the other of physiology. These are to work closely with the recently established unions of biochemistry and physiology and will help to coordinate the activities of these unions with those of the IUBS. The status of the newly established section of experimental psychology was discussed, and it was agreed to support, as an initial activity, an interdisciplinary symposium to be developed by its bureau.

The activities of the union during 1956 were reviewed, plans for 1957 were approved, and tentative plans for 1958 were discussed. The activities of the union fall mainly into the following categories:

1) Sponsorship and partial financial support of the international congresses, organized by the various sections of the union. During 1956, congresses of ento-

mology (Montreal) and limnology (Helsinki) were held; during 1957, congresses of cellular biology (St. Andrews), and photobiology (Turin) are scheduled; for 1958, congresses are planned in zoology (London), biometry (Montreal), genetics (Montreal), ornithology (Helsinki), and microbiology (Stockholm).

2) Sponsorship and (in most cases) financial support of small international symposia. The 1956 symposia were, "Perspectives in marine biology" (La Jolla), "Immunomicrobiological standardization" (Rome), "Cytodifferentiation" (Providence), "Comparative biology of aquatic species" (Roscoff), and "Physical and chemical approaches to problems in chromosomes" (Tokyo). For 1957, the following are scheduled: "Physiology of nerve cells" (Caracas), "Marine phytoplankton" (Norway), "Parasite specificity" (Basel), "Standards and symbols in genetics" (place to be determined), and "Photoperiodism" (Parma). Several are already planned for 1958. Such symposia, as well as the congresses, serve a very useful purpose in bringing together experts in specific fields from the various countries of the world.

3) Publication program. The union publishes the proceedings of the various symposia and makes a contribution toward the printing of congress proceedings. It also contributes to the support of certain international publications, such as the *Zoological Record*, *Biological Abstracts*, and the *Index Herbariorum*. In addition, it publishes a semiannual newsletter.

Some sections of the IUBS are, at the same time, international societies, and some of these also publish serials. Thus, the Biometric Society publishes *Biometrika*, the International Association for Plant Taxonomy and Nomenclature publishes *Taxon*, and the International Society for Cell Biology publishes *Experimental Cell Research* and the *International Review of Cytology*.

4) The union carries on a miscellany of other activities. It supports commissions on botanical, bacteriological and zoological nomenclature. It assists certain important collections, such as the type culture collection of *Drosophila* (at Pavia), and dispenses funds derived from UNESCO, through ICSU, for the

support of type culture collections of microorganisms. It has undertaken, with the cooperation of the Biochemical and Physiological Unions, and with the approval of the abstracting board of ICSU, to establish, in connection with the board, a committee on biological abstracting that will endeavor to bring about, in the biological field, the same degree of international coordination among abstracting services that is now being achieved, through the board, in the physical sciences.

In addition, the union establishes, from time to time, committees or commissions to undertake special assignments or studies. At the present time, there exist committees on biological education, on the preservation, collection, and cataloging of zoological type specimens, on laboratory animals (in cooperation with UNESCO), and on applied ecology, and there is a committee to advise ICSU on the establishment of a joint commission on the biological effects of nuclear radiations. IUBS participates with other unions in joint commissions or cooperative committees on oceanography and applied radioactivity.

The executive committee reviewed these and other activities and made arrangements for their continued support. It also approved a series of recommendations, prepared by A. A. Miles, for the organization of international congresses and symposia. These relate to the frequency, location, size, and organization of such gatherings, and to the publication of their proceedings. Copies of these recommendations may be obtained from Professor R. Ulrich, Laboratoire de Physiologie Végétale, 1 rue Victor Cousin, Paris 5^e, France.

The hospitality of the Centre National de la Recherche Scientifique was greatly appreciated. IUBS members were very much impressed both by the beauty of the surroundings and by the magnificence of the research facilities that are being developed at the Centre. A delightful reception was given in their honor at the Sorbonne by the dean of the faculty of sciences.

The executive committee accepted the invitation of E. Handschin to hold its next meeting in Basel. The 13th general assembly of the Union will be held in London in 1958.

RALPH E. CLELAND

Indiana University

Carbon Conference

A third Conference on Carbon, co-sponsored by the University of Buffalo, the National Science Foundation, and the Office of Naval Research, will be held in Buffalo, N.Y., 17-21 June. Electronic properties of carbons will be con-

sidered in the first 2 days; the following 2 days will be spent on compounds, reactions, effects of irradiation, and heat treatment; and the last day will be devoted to the processing of carbons and to their high-temperature properties.

A total of 80 papers will be presented, 32 of them by speakers from overseas. The program, with abstracts, will be ready for distribution after 15 May. Proceedings will be published sometime after the conference. For further information, registration, and reservation forms, write to the Carbon Conference, University of Buffalo, Buffalo 14, N.Y.

A list of the people from abroad who will be presenting papers at the conference includes: H. Akamatsu, H. Inokuchi, and H. Kuroda (Tokyo); G. E. Bacon (Harwell); R. Baroin (Paris); H. E. Blayden and A. F. Adamson (Newcastle); R. L. Bond and D. H. T. Spencer (B.C.U.R.A.); H. P. Boehm and U. Hofmann (Darmstadt); A. Clauss (Brussels); C. A. Coulson (Oxford); R. C. Croft (Melbourne); R. Diamond (Cambridge); X. Duval (Nancy); V. A. Garten and D. E. Weiss (Melbourne); K. Hedden and E. Wicke (Hamburg); H. Hering, P. Cornuault, and M. Seguin (Saclay); H. Honda (Tokyo); D. J. E. Ingram (Southampton); D. D. Eley (Nottingham); L. E. Lyons, A. Bree, and G. Morris (Sydney); J. Maire and J. Merine (Paris); S. Mizushima (Tokyo); A. Pacault (Bordeaux); J. Parisot and P. Albert (Paris); B. Pullman (Paris); H. L. Riley and C. J. J. Baraniecki (Sheffield); J. Simmons (Harwell); T. Tsuzuku (Namerikawa); R. A. Ubbelohde (London); J. Uebelsfeld (Paris.)

Engineering Education

More than 2000 members and their families are expected for the 65th annual meeting of the American Society for Engineering Education 17-21 June at Cornell University. On the agenda will be most of the urgent problems facing engineering schools today—improving high-school science preparation, increasing the supply of engineering teachers for the rapidly growing enrollments, the problems of research and research manpower in engineering colleges, and more efficient use of colleges' limited facilities and staff.

Among the principal speakers will be W. E. Stirton, vice president of the University of Michigan; Raymond J. Seeger of the National Science Foundation; Eric A. Walker, president of the Pennsylvania State University; W. Kenneth Davis, director of the Division of Reactor Development, Atomic Energy Commission; J. R. Van Pelt, president of the Michigan College of Mining and Technology; and William C. White, vice president of Northeastern University. W. L. Everitt,

dean of the College of Engineering at the University of Illinois, will preside as ASEE president.

During the week-long meeting there will be 130 scheduled events, including meetings of each of the society's 22 divisions. The convention will also include the Engineering College Administrative Council and the Engineering College Research Council.

Participants will include teachers from every field of instruction for engineering students, including English, library sciences, and architecture. There will also be representation from many industries, Government agencies, and publishing houses. Copies of the preliminary program may be obtained on request.

Following the ASEE annual meeting, Cornell will be host to a 10-day workshop for staff members of technical institutes and community colleges.

Cobalt Institute

The first general assembly of the Cobalt Development Institute, which was created on 16 Jan., was held recently in Brussels, Belgium. The following officers were elected: Mr. Robiliart (administrateur délégué of Union Minière du Haut-Katanga), chairman of the institute; E. C. Baring (director of the Rhokana Corporation, Ltd.), vice chairman; and Ch. Piedboeuf (chairman of the Centre d'Information du Cobalt), vice chairman.

The Cobalt Development Institute is a technical and scientific organization made up of the world's major cobalt producers. Its objective is to improve the existing uses of cobalt and to develop new ones. The Belgian limited liability company Centre d'Information du Cobalt has been entrusted with the execution of the institute's program. The center is located in Brussels, at 35, rue des Colonies, and is represented in the United States by the Cobalt Information Center at the Battelle Memorial Institute in Columbus, Ohio. A research program of fundamental studies is being sponsored and, through the dissemination of technical data, the information centers assist users and potential users of cobalt.

Society Elections

■ Eastern Psychological Association: pres., Stuart Cook, New York University; past pres., Fred S. Keller, Columbia University; sec., C. Gorham Lane, University of Delaware; treas., Roy B. Hackman, Temple University.

■ American Society of Human Genetics: pres., William C. Boyd, Boston University; past pres., Curt Stern, University of

California; pres.-elect, Madge T. Macklin, Ohio State University; v. pres., Frederick Osborn; sec., Eldon J. Gardner, Utah State University; treas., H. Warner Kloepper, Tulane University.

■ American Society for Artificial Internal Organs: pres., P. F. Salisbury; pres.-elect, G. H. A. Clowes; sec.-treas., G. Schreiner.

■ American Academy of Psychotherapists: pres., Carl R. Rogers, University of Chicago; v. pres., Jerome M. Schneck, State University of New York College of Medicine at New York City; sec.-treas., George Dolger, 11 Riverside Dr., New York, N.Y.

■ National Speleological Society: pres., Brother G. Nicholas, La Salle High School, Cumberland, Md.; sec., Frances Cross, 125 Tapawingo Rd., SW, Vienna, Va. The vice presidents are Thomas C. Barr, George F. Jackson, Oscar W. Hawksley, and Dorothy Reville. Representative to the AAAS Council is Brother G. Nicholas.

■ Society for Research in Child Development: pres., Roger A. Barker, University of Kansas; sec., Dale B. Harris, University of Minnesota. Members of the Governing council are Charles A. Janeway, Harvard Medical School, and W. M. Krogman, University of Pennsylvania.

Forthcoming Events

June

8-11. American Planning and Civic Assoc., annual, Little Rock, Ark. (Miss H. James, APCA, 901 Union Trust Bldg., Washington 5.)

8-13. X-Ray Technicians, internat'l. convention, Washington, D.C. (Miss M. A. Snyder, 1165 W. Water St., Elmira, N.Y.)

9-12. American Inst. of Chemical Engineers, Seattle, Wash. (F. J. Van Antwerpen, AIChE, 25 W. 45 St., New York 36.)

9-13. American Rocket Soc., semiannual, San Francisco, Calif. (J. J. Harford, ARS, 500 Fifth Ave., New York 36.)

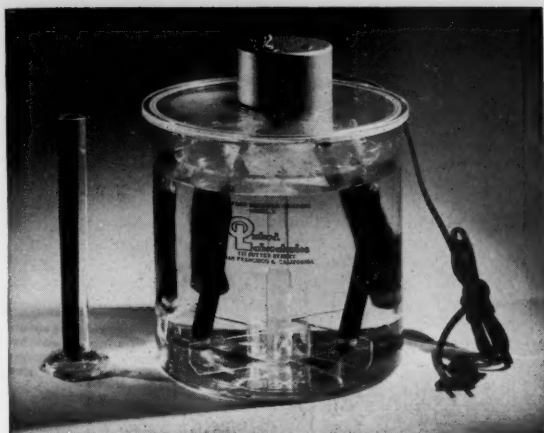
9-13. American Soc. of Mechanical Engineers, semiannual, San Francisco, Calif. (C. E. Davies, ASME, 29 W. 39 St., New York 18.)

10-12. American Nuclear Soc., 3rd annual, Pittsburgh, Pa. (W. W. Grigorieff, ANS, P.O. Box 963, Oak Ridge, Tenn.)

10-12. Canadian Soc. of Microbiologists, annual, London, Ont., Canada. (J. A. Carpenter, Dept. of Bacteriology, Ontario Agricultural College, Guelph.)

10-14. Molecular Structure and Spectroscopy Symp., Columbus, Ohio. H. H. Nielsen, Dept. of Physics and Astronomy, Ohio State Univ., Columbus 10.)

10-14. Technical Writers' Institute, 5th annual, Troy, N. Y. (J. R. Gould, TWI, Rensselaer Polytechnic Inst., Troy.)



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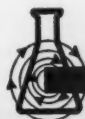


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11-13. American Meteorological Soc., Monterey, Calif. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

11-15. Ionization Phenomena in Gases, 3rd internat. conf., Venice, Italy. (U. Facchini, Laboratori CISE, Via Procaccini 1, Milan, Italy.)

12-15. Colloquium of College Physicists, 19th annual, Iowa City, Iowa. (J. A. Van Allen, Dept. of Physics, State Univ. of Iowa, Iowa City.)

16-20. American Soc. of Mammalogists, annual, Lawrence, Kansas. (B. P. Glass, Dept. of Zoology, Oklahoma A.&M. College, Stillwater.)

16-21. American Soc. for Testing Materials, Atlantic City, N.J. (R. J. Painter, ASTM, 1916 Race St., Philadelphia 3.)

17-19. American Neurological Assoc., Atlantic City, N.J. (C. Rupp, 133 S. 36 St., Philadelphia 4, Pa.)

17-19. Astronomical Soc. of the Pacific, annual, Flagstaff, Ariz. (S. Einarsson, Univ. of California, Berkeley 4.)

17-19. Health Physics Soc., 3rd annual, Pittsburgh, Pa. (H. W. Patterson, Radiation Lab., Univ. of California, Berkeley.)

17-19. Military Electronics, national convention, Washington, D.C. (G. Rapoport, Emerson Radio & Phonograph Corp., 701 Lamont St., NW, Washington 10.)

17-20. Carbon Conf., 3rd, Buffalo, N.Y. (Carbon Conf., Univ. of Buffalo, Buffalo.)

17-20. Institute of Aeronautical Sciences, natl. summer, Los Angeles, Calif. (S. P. Johnston, IAS, 2 E. 64 St., New York 21.)

17-21. American Soc. for Engineering Education, annual, Ithaca, N.Y. (W. L. Collins, Univ. of Illinois, Urbana.)

17-21. Association of Official Seed Analysts, annual, Baton Rouge, La. (L. C. Shenberger, Seed Lab., Dept. of Agricultural Chemistry, Purdue Univ., Lafayette, Ind.)

17-21. Canadian Medical Assoc., 90th annual, Edmonton, Alberta, Canada. (CMA, 244 George St., Toronto, Ont.)

17-22. Coordination of Galactic Research, internat. symp., Stockholm, Sweden. (P. T. Oosterhoff, University Observatory, Leiden, Netherlands.)

17-22. Internal Combustion Engine Cong., 4th internat., Zurich, Switzerland. (C. C. M. Logan, British National Committee, 6 Grafton St., London, W.1.)

17-28. Wear Theory in Metal Cutting and Bearing Design, special summer program, Cambridge, Mass. (Massachusetts Inst. of Technology, Cambridge 39.)

19-21. Association for Computing Machinery, annual, Houston, Tex. (J. Moshman, ACM, 2 E. 63 St., New York 21.)

20-22. American Assoc. of Physics Teachers, annual, Schenectady, N.Y. (F. Verbrugge, School of Physics, Univ. of Minnesota, Minneapolis.)

20-22. American Physical Soc., Notre Dame, Ind. (K. K. Darrow, APS, Columbia Univ., New York 27.)

20-22. Soc. of Nuclear Medicine, 4th annual, Oklahoma City, Okla. (R. Lackey, SNM, 452 Metropolitan Bldg., Denver, Colo.)

21-23. American Assoc. of Bioanalysts,

annual, New Orleans, La. (G. Hoffman, 3707 Gaston, Suite 419, Dallas, Tex.)

22-28. American Soc. of Medical Technologists, annual, Chicago, Ill. (Miss R. Matthaei, ASMT, Suite 25, Hermann Professional Bldg., Houston 25, Tex.)

23-26. American Soc. of Agricultural Engineers, E. Lansing, Mich. (J. L. Butt, ASAE, St. Joseph, Mich.)

23-28. American Physical Therapy Assoc., annual, Detroit, Mich. (Miss M. E. Haskell, APTA, 1790 Broadway, New York 19.)

23-28. National Assoc. of Power Engineers, natl., Grand Rapids, Mich. (E. J. Schuetz, NAPE, 176 W. Adams St., Chicago 3, Ill.)

23-29. American Library Assoc., annual, Kansas City, Kans. (D. H. Clift, ALA Hq., 50 E. Huron St., Chicago 11.)

23-30. Rheumatic Diseases, 9th internat. cong., in conjunction with American Rheumatism Assoc., Toronto, Ont., Canada. (E. Dunlop, Box 237, Terminal "A," Toronto.)

24-26. Aging, 10th conf., Ann Arbor, Mich. (Div. of Gerontology, Univ. of Michigan, Rackham Bldg., Ann Arbor.)

24-26. American Soc. of Heating and Air-Conditioning Engineers, Murray Bay, Quebec, Canada. (A. V. Hutchinson, ASHAE, 62 Worth St., New York 13.)

24-27. Agricultural Inst. of Canada, with six other Canadian agricultural socs., annual, Vancouver, B.C. (W. J. Anderson, Dept. of Agricultural Economics, Univ. of British Columbia, Vancouver.)

(See issue of 19 April for comprehensive list)

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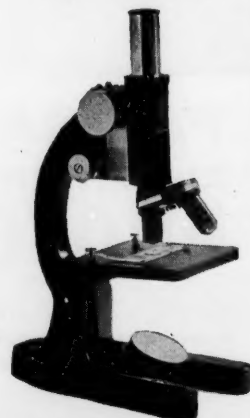
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LETTERS

The editors take no responsibility for the content of the letters published in this section. Anonymous letters will not be considered. Letters intended for publication should be typewritten double-spaced and submitted in duplicate. A letter writer should indicate clearly whether or not his letter is submitted for publication. For additional information, see *Science* 124, 249 (1956) and 125, 16 (4 Jan. 1957).

"Living" Molecule

G. W. Beadle's recent suggestion [*Science* 125, 9 (1957)] that nucleic acids might be regarded as the first "living" molecule presents an opportunity to re-emphasize the fact that such interesting speculations must still be regarded as highly controversial. It would be unfortunate if too little theoretical and experimental consideration continues to be given to alternate views (i) that genes are recent [C. C. Lindegren, *Nature* 176, 1244 (1955); *N.Y. Acad. Sci.* (Dec. 1956)] rather than primary, and (ii) that they may act, to a large extent by inhibiting a "totipotent" cytoplasm [W. Braun, *Science* 104, 38 (1946); B. Commoner, report at AAAS meeting (Dec. 1956)]. Bateson's [W. Bateson, *Problems of Genetics* (Yale Univ. Press, 1913)] and Goldschmidt's [R. B. Goldschmidt, *The Material Basis of Evolution* (Yale Univ. Press, 1940)] arguments that gene mutation per se does not afford a satisfactory explanation of evolution still remain to be answered.

CARL C. LINDEGREN
Biological Research Laboratory,
Southern Illinois University, Carbondale
WERNER BRAUN
Institute of Microbiology, Rutgers
University, New Brunswick, New Jersey

The Sick Feeling Remains

On 1 March, I learned, via your editorial [*Science* 125, 381 (1957)], all about triage. A little sober reflection eliminated the first waves of nausea, but the sick feeling remains. It is difficult to reconcile a civilized spirit with the science (if this is what it is) of triage.

This is not written in criticism of Ziperman or of DuShane; indeed, I thank you for introducing me to this macabre game. With a little imagination, we can envision the glorious band which has survived five or six consecutive disasters through the Machiavellian hand of the "sorting officer." Naturally, the "sorting officer" of the hostile power will have weeded out his necessary and superior crop. Thus the world (if there be one left) will be minus the everyday human flotsam and will be happily inhabited by those necessary to survival—including "sorting officers."

It is devoutly hoped that more time, energy, and diplomacy will be channeled into avoiding these "civilian disasters," so that triage and its disciples are left without a future.

ERIC WINSTON
7814 Provident Street,
Philadelphia, Pennsylvania

Limited Attendance

There is a statement in "Social aspects of science" [*Science* 125, 145 (25 Jan. 1957)] to the effect that our recent Conference on the Practical Utilization of Recorded Knowledge found it necessary to hold parts of its deliberations behind closed doors and to refrain from publicizing the full record of these "confidential" sessions.

The sessions were not confidential, but rather attendance was limited to those in various subject areas who might contribute best to these sessions. As per plan, summaries of these sessions have been published in the book *Documentation in Action*, edited by Shera, Kent, and Perry (Reinhold, New York, 1956), which records the proceedings of the conference.

We believe that the technique of limiting attendance in certain types of meetings helps to stimulate discussion by spe-

cial interest groups who might otherwise be inhibited from presenting their views in public. This was indeed the case in these sessions.

ALLEN KENT
Center for Documentation and
Communication Research, Western
Reserve University, Cleveland, Ohio

Damaging Rumor

The main part of your editorial "Scotching a damaging rumor" [*Science* 125, 7 (4 Jan. 1957)] is a letter from the State Department, the contents of which seem to be quite clear. Contrary to your belief, however, the letter will be considered by a great many people abroad as a definite confirmation of the absolute truth of the "damaging rumor."

The State Department definitely says that one visit may not be damaging—"Repeated visits . . . may raise a question as to the visa applicant's political affiliations."

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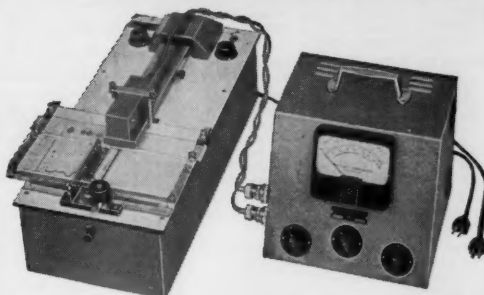
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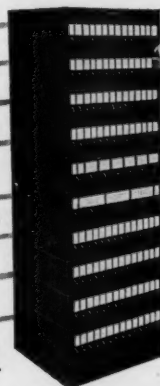
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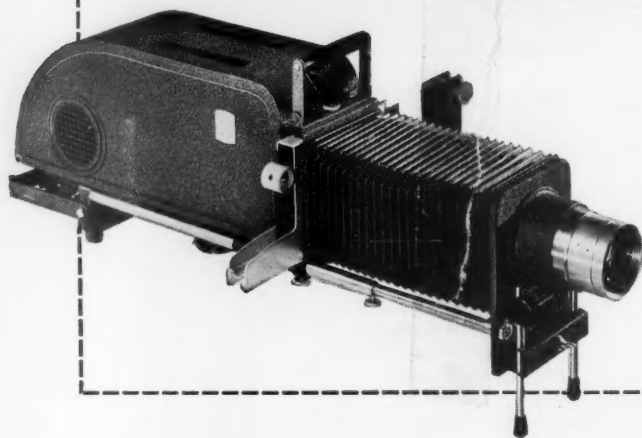
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